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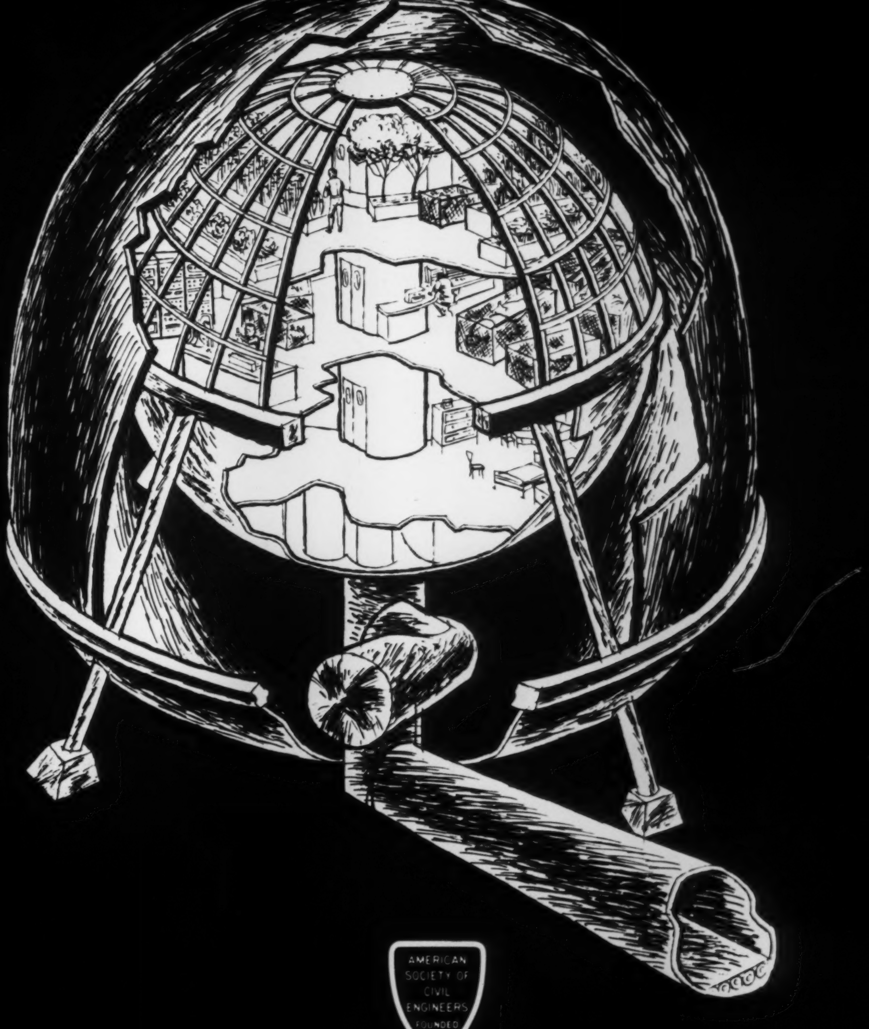

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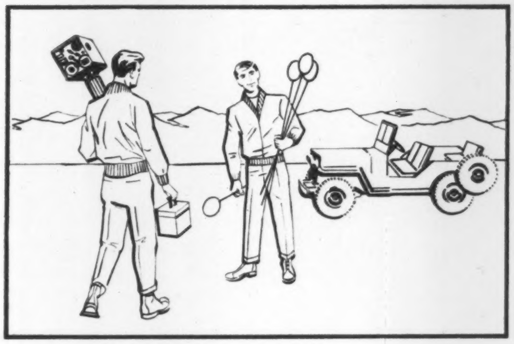

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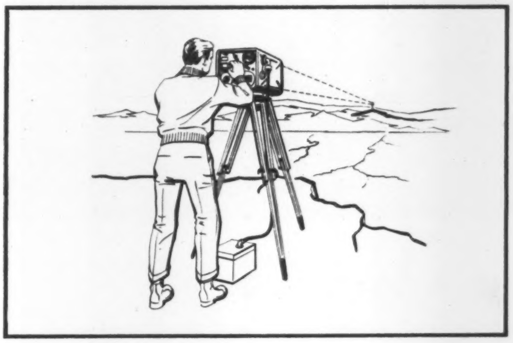

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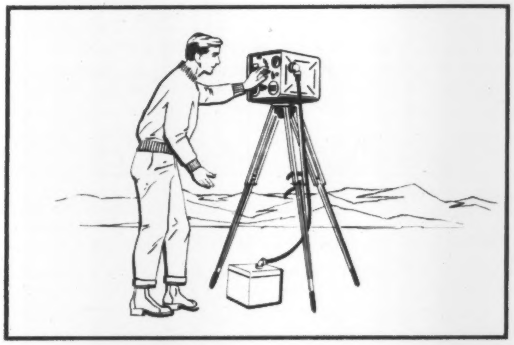

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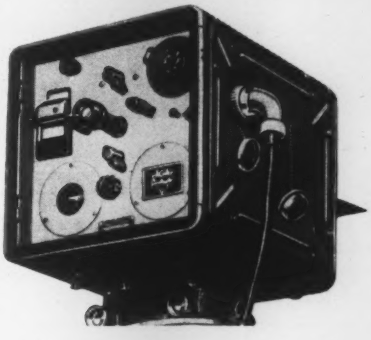

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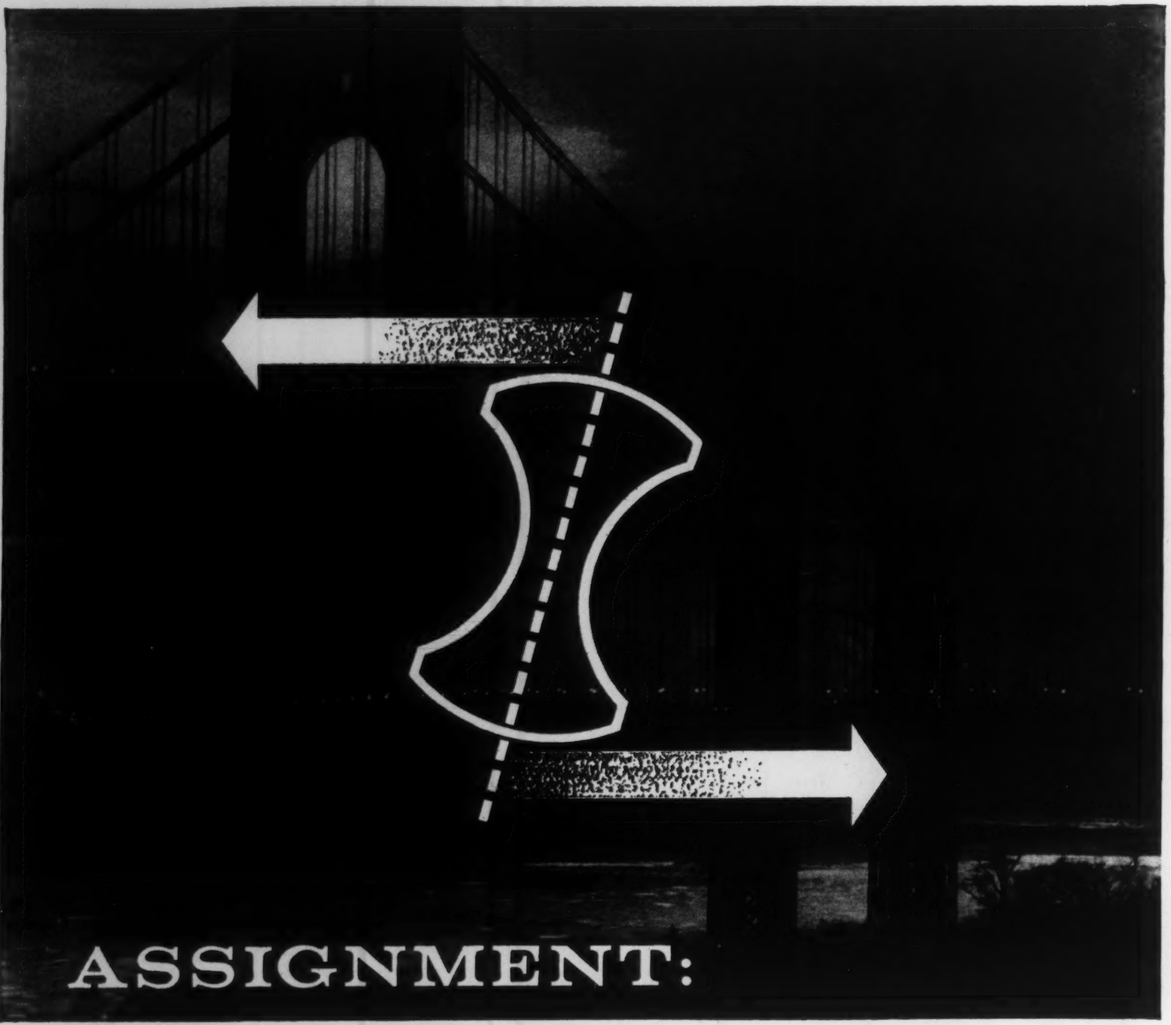

ASSIGNMENT: EXPANSIVITY

How Lukens *Application Research* can help you find the right steel plate for the job

In solving problems of expansivity, the experience of our Application Engineering staff is long and varied. And it's yours for the asking.

For example, a growing number of bridges expand and contract on *bearing plates* of Lukens stainless-clad steel. Extensive research led to the first such application. Tests run jointly with a consulting firm and a large university put Lukens clad steel plate through 2 million passes under a 100,000 pound loading—without harm. There was actually evidence that the bond between the backing steel and its stainless cladding grows stronger.

All the safety factors of corrosion-resistant stainless are present in stainless-clad—at significantly lower cost than 100% high alloy.

Since this initial research, many such bearing plate applications have been made—and their performance compared with that of other materials. Today, The Walt Whitman, Greater New Orleans, Rappahannock River, Throggs Neck, and a number of smaller highway bridges, are cradled on these safe, money-saving plates. The knowledge accumulated by Lukens' Application Engineers in this area and others is available to help guide you in your design problems.

That's why we say, *if your assignment is expansivity, let it be our assignment too.* Contact Manager, Application Engineering, 1109 Services Building, Lukens Steel Company, Coatesville, Pa.

ASK FOR THE BULLETIN ON BRIDGE BEARING PLATES

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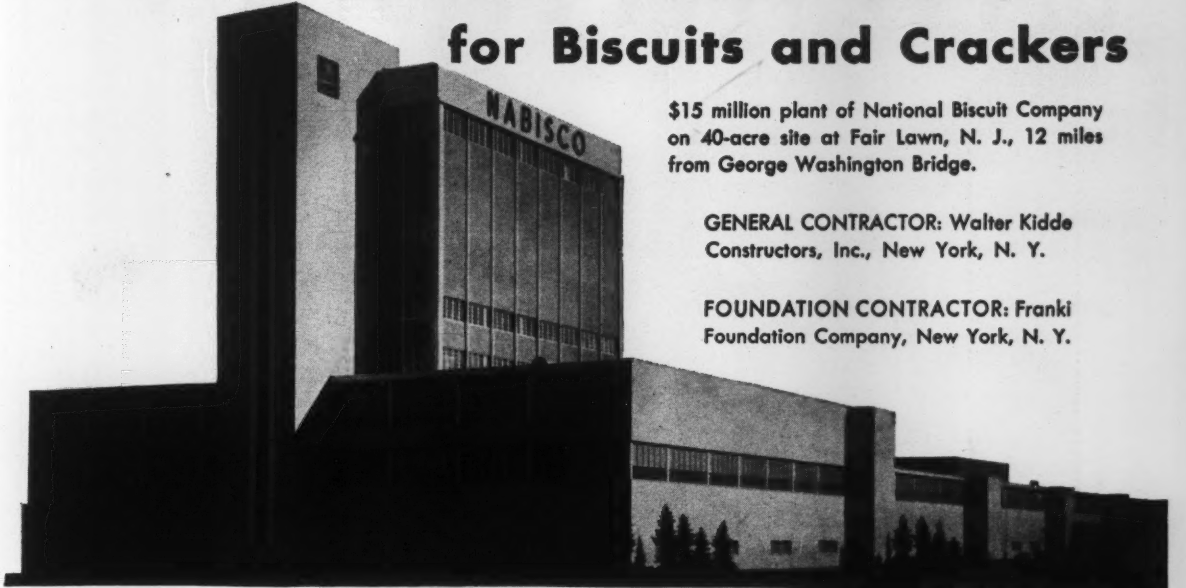


$15 million plant of National Biscuit Company on 40-acre site at Fair Lawn, N. J., 12 miles from George Washington Bridge.

GENERAL CONTRACTOR: Walter Kidde Constructors, Inc., New York, N. Y.

FOUNDATION CONTRACTOR: Franki Foundation Company, New York, N. Y.

164-Foot High Tower Section for Raw Materials Storage and also 2-Story Laboratory Built on Franki Displacement Caissons Bearing in Granular Subsoil.

This newest of 10 Nabisco bakeries and a major unit in a $180 million expansion and modernization program was designed and its construction supervised by the Company's own engineering department.

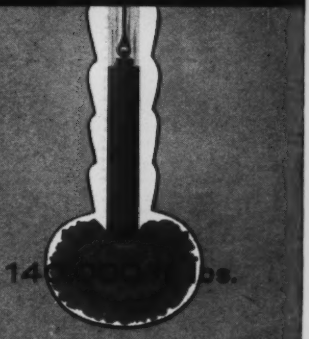
When borings for the tower section at the north end of the plant showed granular subsoil, Nabisco engineers recognized that displacement caissons with expanded base footings would provide a solid and most economical foundation. The tower is primarily for storage of 75 carloads of raw materials with mixing departments in the lower area.

After Franki engineers completed additional soil tests, two rigs installed 407 Franki Displacement Caissons at depths averaging 20 feet below grade, at a rate of better than 6 per day per rig during 36 driving days of cold December and January weather. Groups of caissons carry column loads as high as 940 tons.

Later, Franki engineers were called in again, this time for the foundations for an adjoining two-story Research and Development Laboratory at the south end of the four-block long bakery. A single rig installed 130 Franki Displacement Caissons in 20 driving days at average driven depths of 21 feet.

These two Nabisco installations, like other Franki work, were quoted on a lump sum basis without qualification or payment for excess footage. All work was guaranteed.

Consult Franki engineers on your foundation problems.



Advantages of Franki Methods

A Franki Displacement Caisson, with its surrounding compacted earth mass, exploits the maximum bearing capacity of the soil.

Every Franki pressure-injected-type footing of "dry"* concrete is "forged" with 140,000 foot-pound blows of a falling ram, a force many times greater than the blow of a steam or pneumatic hammer.

As a result, the advantages are:

1. High unit load capacity due to expanded base made in granular soil.
2. Economy because fewer Franki caissons of shorter length are required.
3. Volume of reinforced concrete caps is reduced to a minimum with corresponding savings in cap excavation, sheeting, reinforcing, forms and backfill.
4. Concreting of shaft can be made at any cutoff elevation below grade. Installation can be made in advance of general excavation with resulting saving in sheeting, bracing and maintenance. Depending on water table elevation, economies in pumping costs may also result.

*"Dry" concrete is defined as zero slump concrete using approximately 3½ gallons of water per bag of cement.

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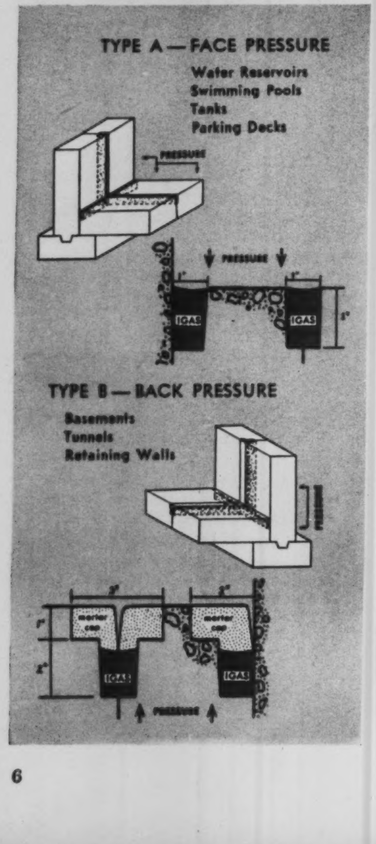
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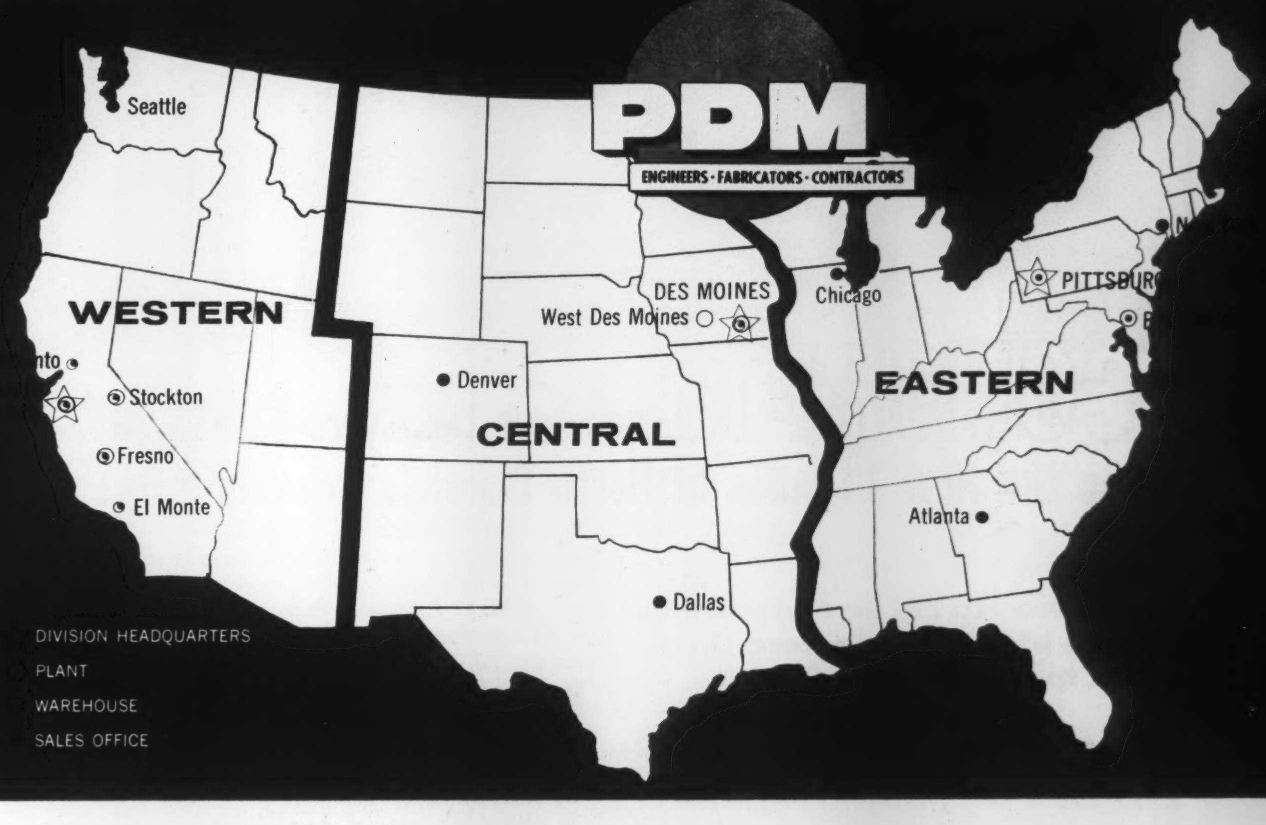

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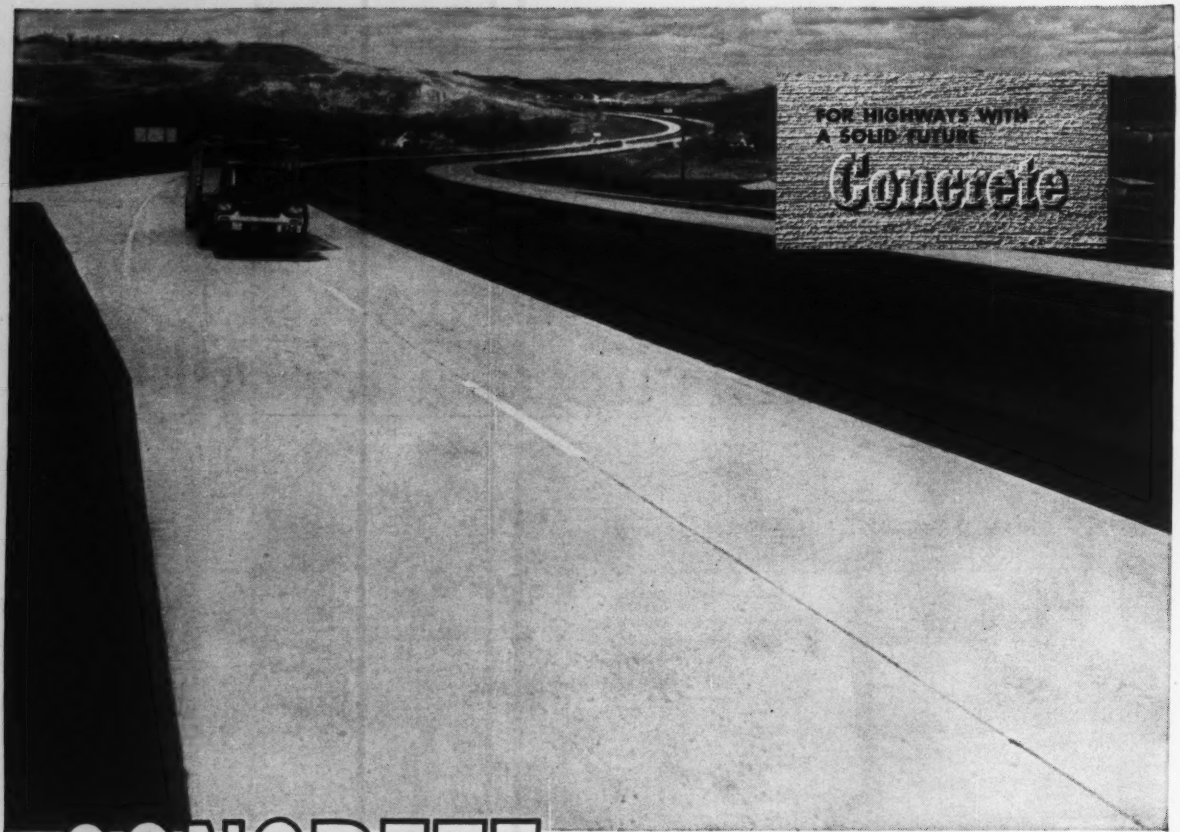

CONCRETE will save taxpayers $2,835,000 on the first 39 miles of North Dakota's Interstate 94!

North Dakota chose concrete to get the big savings where they count most—on upkeep

On the 39-mile stretch between Jamestown and Valley City—and for other sections of the Interstate System—North Dakota had good reasons for choosing concrete. *Concrete means tax savings and real dollar value.*

In North Dakota it was found that by comparing amortized first costs plus surface maintenance costs for concrete and asphalt, *concrete will save $72,200 per mile in 35 years.*

Estimates were based on maintenance costs shown in an official study of pavements in 28 reporting states. And because the asphalt design being considered would require two resurfacings, this cost was figured in, too. Bureau of Public Roads life expectancy studies gave the schedule for such resurfacings. Final figures evidenced impressively the sizable year-after-year savings provided by concrete!

The reasons are simple enough! Concrete needs no special seal coatings, no periodic resurfacings—both costly items. There's far less routine maintenance, too.

Concrete is nonflexible . . . it has *beam* strength it never loses. In fact, concrete grows stronger year by year. Modern, air-entrained concrete gives built-in protection against damage caused by freezing and thawing.

Concrete highways 35 years old are a matter of record. Today's modern concrete promises 50 years and more of smooth going for drivers. Thrifty concrete on the Interstate System leaves more funds for other highways. Concrete means true economy for taxpayers, both today and in the future. It's easy to see why concrete is the preferred pavement for important highways.

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Mine-to-main control assures U. S. Pipe quality in service

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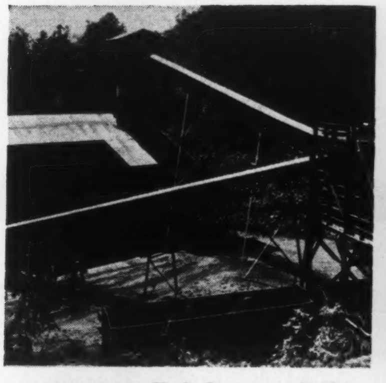
Water officials are doing an outstanding job keeping the nation's water pitcher filled. Cast iron pipe is their most dependable ally.

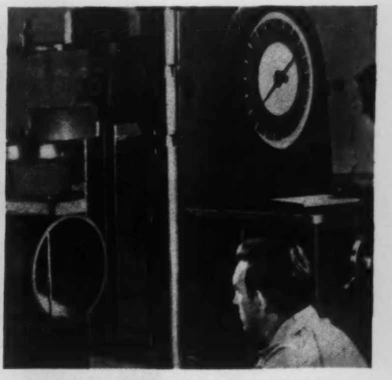
To furnish that dependability ... in every detail ... U. S. Pipe controls production every step of the way. From mine to final shipping U. S. cast iron pipe is subjected to intensive quality checks. . . checks to provide long life, efficiency, trouble-free service.

Quality is built into U. S. cast iron pipe.



CLEANING ORE. U. S. Pipe ore cleaning plant at a mine where ore is crushed and passed through separators to float off impurities.

MOLTEN IRON in a measured amount is poured into a machine ladle, preparatory to the start of the centrifugal casting cycle.



VIGILANCE. Specimens of U.S. Pipe are periodically subjected to a ring crushing test in a 200,000 pound universal testing machine.

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there's an Inland construction steel for everyone

These days, a lot of bright architects and engineers who aren't afraid of new ideas, are turning the construction business upside-down. Everywhere one looks, new techniques, new materials, daring new concepts, are changing the face of America. Yet, as every practical contractor can tell you, all of these new-direction ideas are firmly based upon the proven strength and dependability of steel.

Here in the Midwest, where Inland Steel Company's strategic location offers definite service advantages, builders have come to rely on the excellent quality and wide range of construction steel products made available by Inland. There's an Inland Sales Office near you.

A fully integrated steel mill with the technical skill, the products, and the experience to help you solve your steel construction problems.

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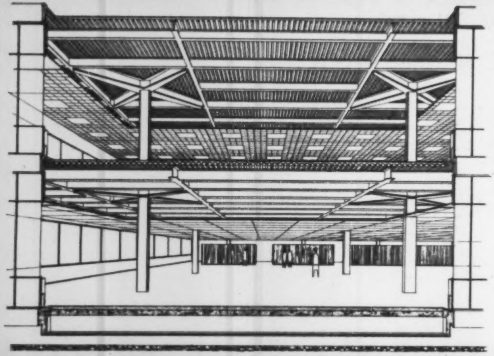
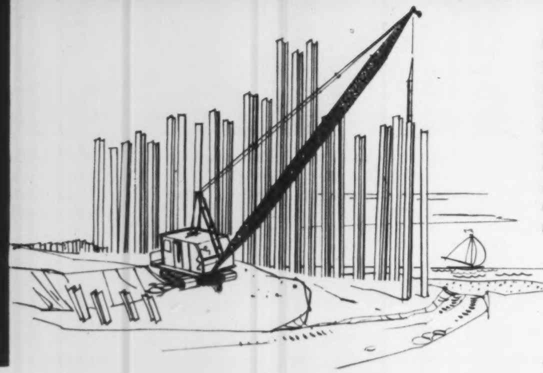
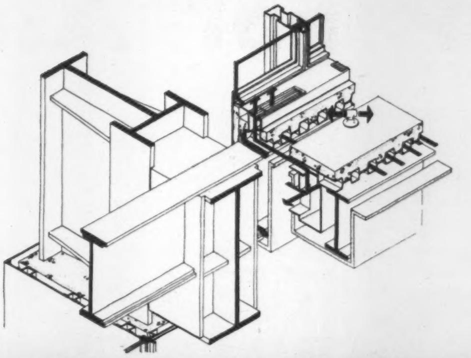


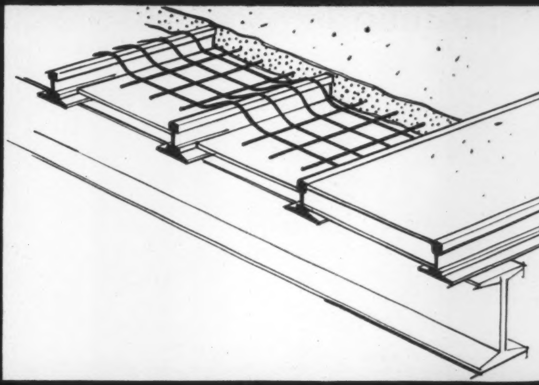
umbrella cross heads speed construction—add interesting design note—For this handsome and highly utilitarian structure, the key to the structural steel system was unique cross heads made up of Inland Wide Flange Beams. Welded into an umbrella-like design they were prefabricated into single units. On the job each unit was fastened to a supporting column using standard connections with a minimum of field welding. 36 such units were used per floor with 35 feet between supporting columns, thus providing 35-foot clear span square bays throughout. Interesting also, is the resultant 17½ foot cantilevered overhang around the entire perimeter.



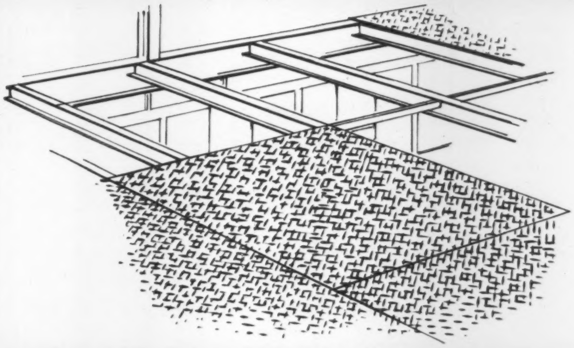
water, water, everywhere! Sand shores make wonderful bathing beaches, but anchoring a huge building in such material can be a headache. In the construction of an enormous exhibition hall right on the lakefront Inland bearing piles did yeoman service. More than 6,000 tons of piling were used and though the Great Lakes are noted for the fury of their storms, the new exposition center will ride them out without a quiver.



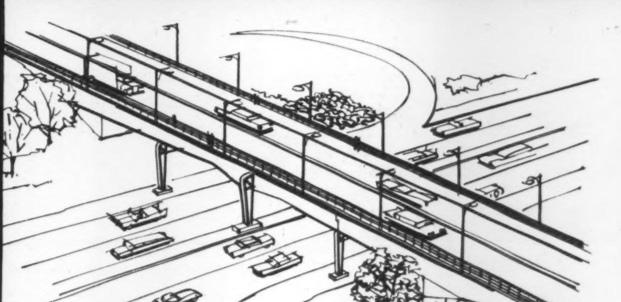
unique solution to a building frame problem—This special "torque" joint was the answer to a number of problems in the construction of a building frame where wind load was an important factor. The joint distributed the load between columns and spandrels as well as distributing both live and dead load between columns and girders. Fabricated from Inland Steel Plate at the same time as the vertical supporting columns, the "torque boxes" made field connection with girders a quite simple job. Note also the cellular floor construction—an Inland solution to the problem of handling phone, heating, cooling, utility ducts of all kinds.



weight-saver for short-span roofs . . . Inland sub-purlins—Inland sub-purlins are especially designed to provide a lighter, more efficient member for shorter-span roof construction. In addition, they make a real contribution to the modern good-looks so evident in today's construction. Installation is fast, easy, and entirely without waste, for Inland sub-purlins are cut to the length required for the specific roofing job. Mill painted, ready for clipping or welding to the purlin member, they're ideal for gypsum, aggregate or grout fill—all types of pre-cast or poured roofs.

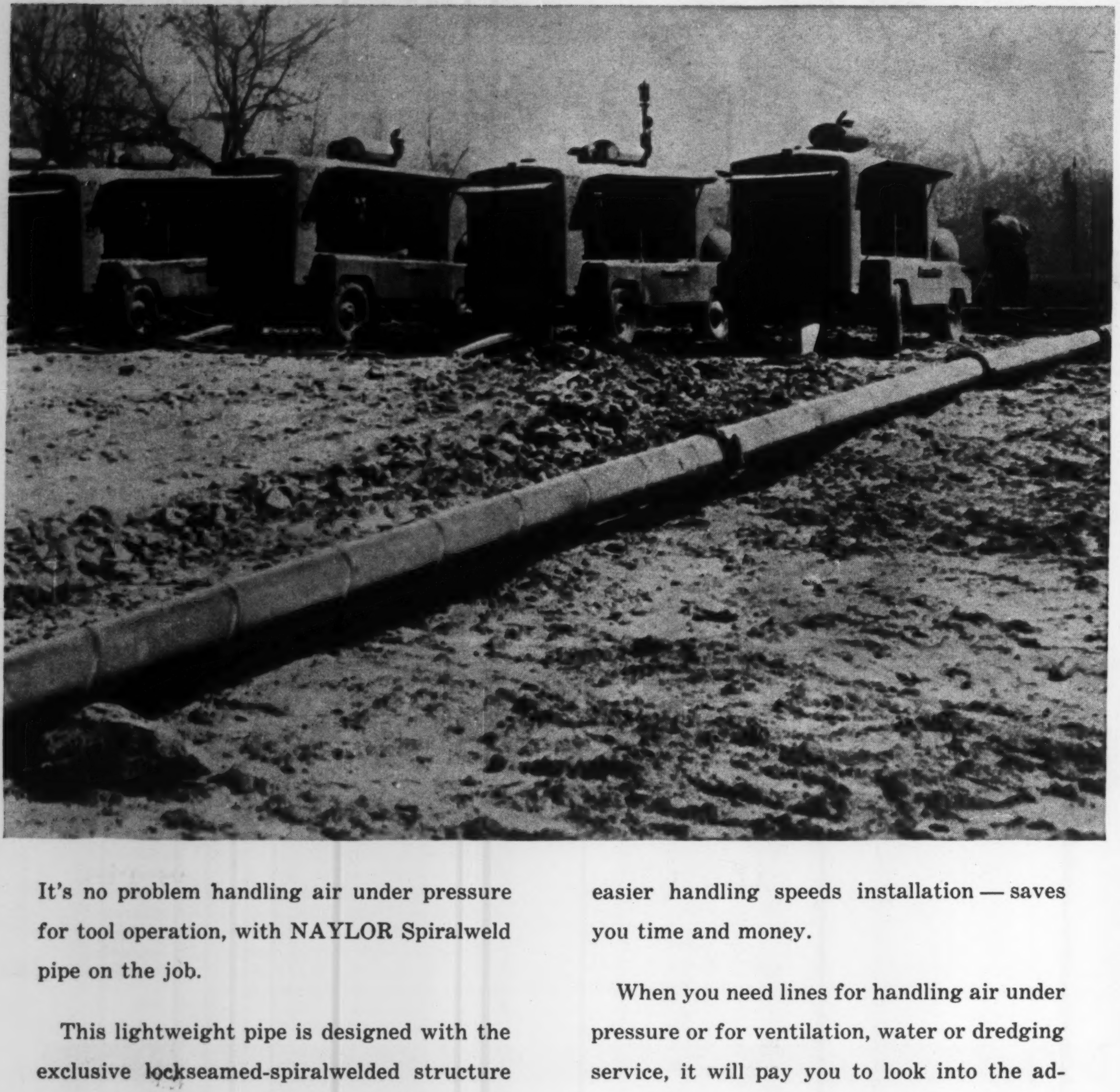


new way to take advantage of prefabricated floor plate—The inherent strength of versatile Inland 4-Way Safety Plate permits its use as an integral part of the supporting structure. Used everywhere as a long-lasting material for floors, walls and stairs in industrial plants and institutional buildings, 4-Way Safety Plate is here used as part of the supportive framework. ¼ inch floorplate was used and a remarkable design span of 48 inches between centers was achieved. Additional advantages on this job were ease of cleaning and maintenance, fire safety, and slip-proof protection for future tenants and their employees.



how to stretch a girder for 500 feet—Inland Plate and Structural steel is doing its bit to make the nation's network of superhighways a reality. To span an overpass under construction in the very heart of a huge metropolitan city, Inland prefabricated sections for the enormous girders. Fifty such sections ranging from 80 feet to 120 feet in length and tapered 4½ feet to 7 feet in height were built-up from Inland plate, transported to the site where they were welded into giant girders stretching for more than 500 feet to support multiple-lane roadways.

PIPE LINE-UP For Air!



It's no problem handling air under pressure for tool operation, with NAYLOR Spiralweld pipe on the job.

This lightweight pipe is designed with the exclusive lockseamed-spiralwelded structure to give you extra strength and safety required in "high" air service. At the same time, its easier handling speeds installation — saves you time and money.

When you need lines for handling air under pressure or for ventilation, water or dredging service, it will pay you to look into the advantages of NAYLOR pipe. Ask for Bulletin No. 59.

NAYLOR
PIPE *Company*

1281 East 92nd Street, Chicago 19, Illinois
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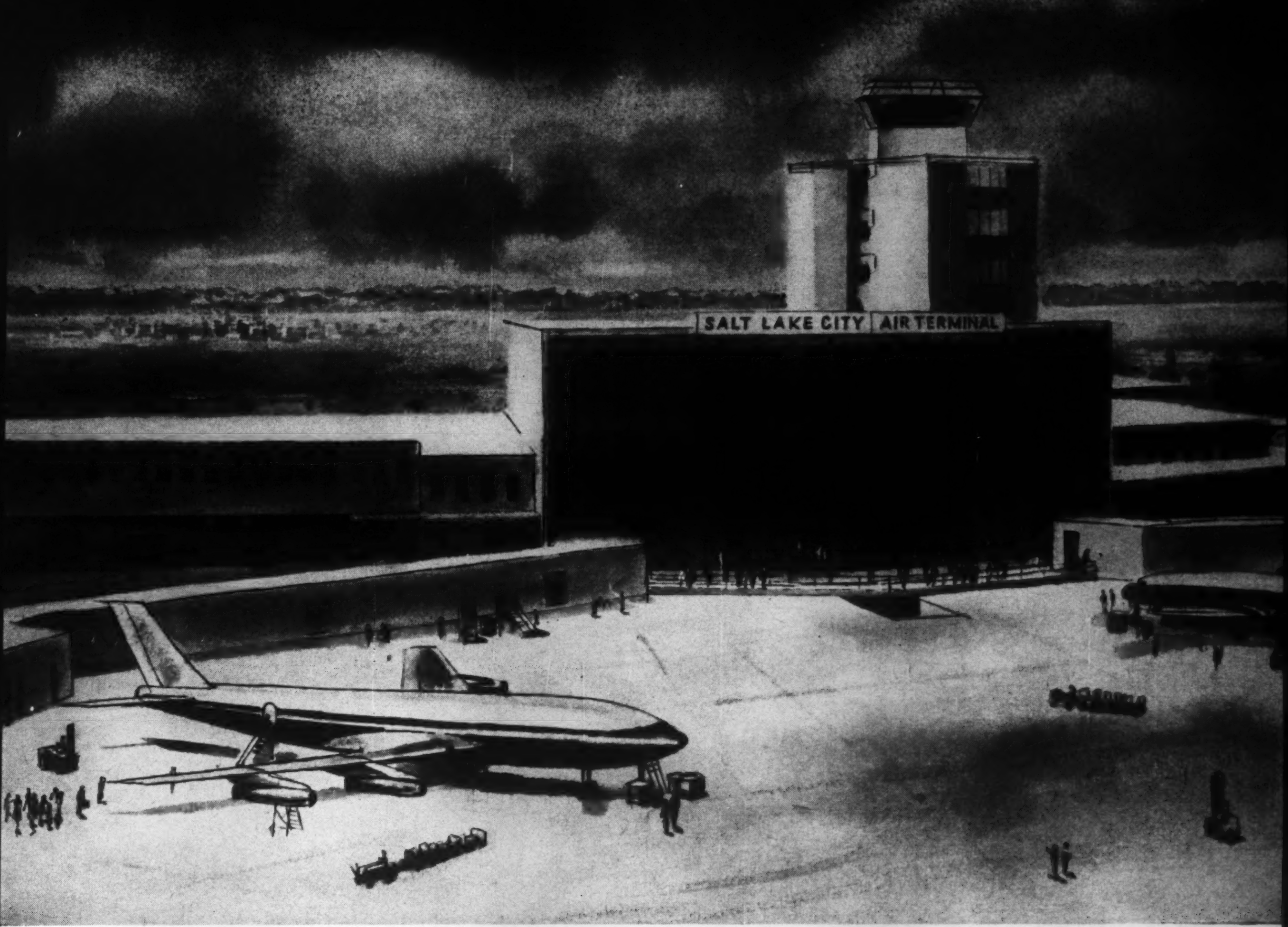

SALT LAKE CITY AIR TERMINAL

Owner: Salt Lake City Corporation • Architect and Engineer: Ashton, Evans & Brazier • General Contractor: Christiansen Brothers.

For America on the wing, more new facilities rising on

RAYMOND FOUNDATIONS

AMONG the many varieties of foundations installed by Raymond, none is more vital to a growing America than air terminal facilities. Raymond's latest in the field, shown here in this rendering, is the Municipal Air Terminal in Salt Lake City, Utah. Scheduled for completion late in 1960, the Terminal will rest on 380 Raymond step-taper piles, a total of 18,394 linear feet.

No foundation project is too large or too small to benefit from Raymond versatility and experience. So, if there's a foundation in your future, we shall be pleased to talk to you.

RAYMOND
CONCRETE PILE COMPANY
A Division of Raymond International Inc.

140 CEDAR STREET, NEW YORK 6, NEW YORK

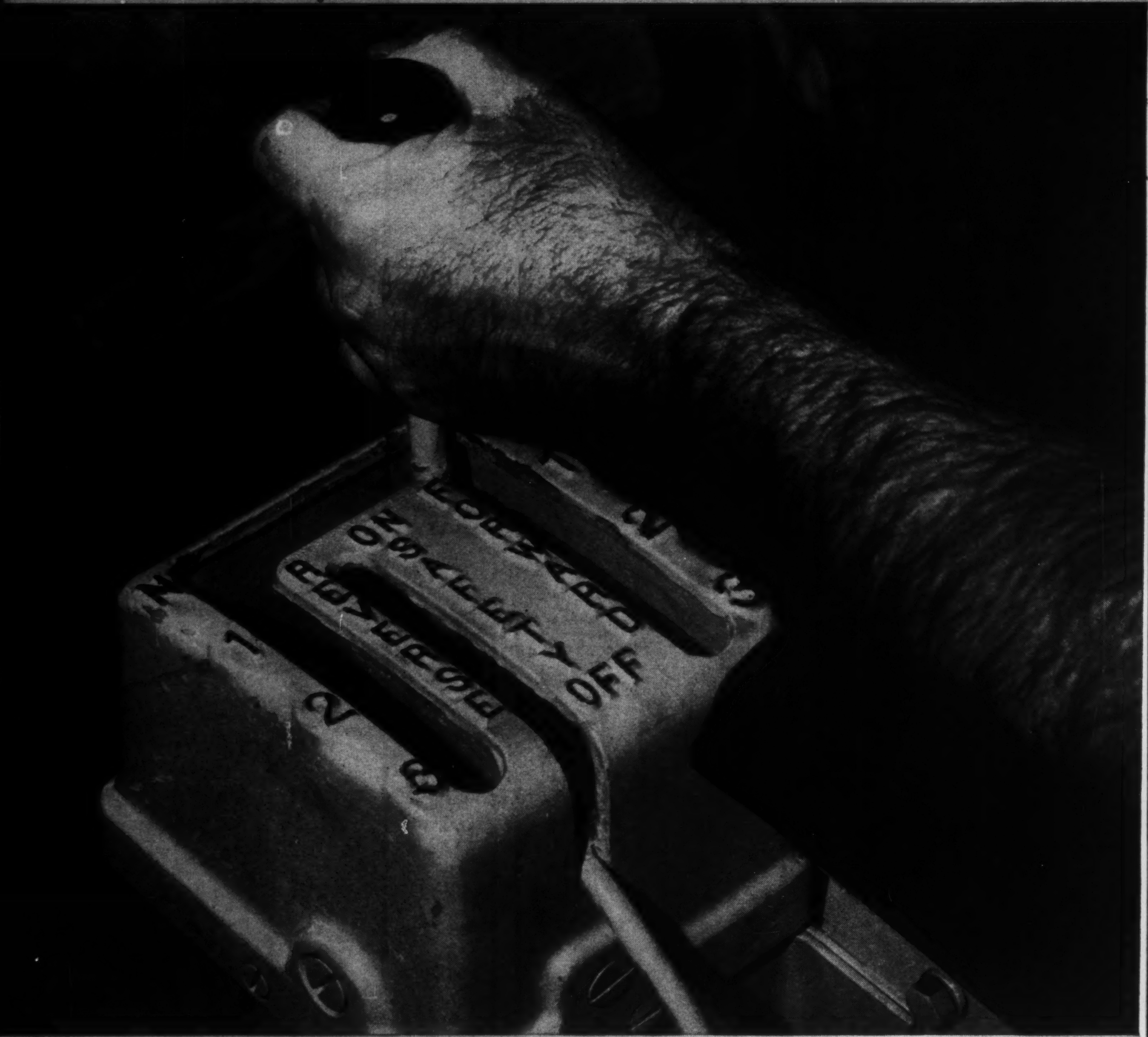
Branch offices in the principal cities of the United States. Subsidiaries in Canada, Central and South America and other countries.

FOUNDATIONS FOR THE STRUCTURES OF AMERICA . . . COMPLETE CONSTRUCTION SERVICES ABROAD

CATERPILLAR'S
No. 1
PROJECT

*PAYS OFF FOR YOU AGAIN**

New Cat Power Shift Transmission for D9 and D8 Tractors



CONTROL is mounted to the left of the operator. One selector lever eliminates gearshift, forward-reverse and flywheel clutch levers. The safety lever prevents accidental transmission engagement. The selector lever moves in a "U" path to various positions. To the left are three reverse speeds. To the right, three forward speeds. To change speed, simply move lever to the required position. To change travel direction, move lever to the opposite side. Changing speed and direction are as easy as that—without clutching—changes can be made while the machine is in motion under full load without loss of power or momentum.

HIGHER PRODUCTION PUSHLOADING: Power is quickly, easily adjusted to meet the demand. Shifting to higher gear boosts scraper out of cut quickly at higher speed. Speedy reverse quickly positions machine for next push.

HIGHER PRODUCTION BULLDOZING: As material builds up, Cat power shift transmission permits split-second shifting. There's a minimum of forward surge when the load is dropped. Instant reversing further slashes cycle time.

- **Shifts on-the-go under full load in a split-second!**
- **Changes speed, reverses direction with finger-tip control lever—and no clutching!**

The wraps are off—it's ready. After many years of research and on-the-job testing, Caterpillar now offers a revolutionary new drive for Cat D9 and D8 Tractors—power shift transmission. This new transmission—with an exclusive design—provides production highs never before possible with a track-type tractor. Here's why:

1. It combines for the *first* time the flexibility and anti-stall features of torque converter with the operating snap of direct drive. Because of its direct drive characteristics, it is more efficient than other power shifts.

2. With one control lever and no clutching, it reverses direction . . . changes speed . . . smoothly . . . under full load . . . in a fraction of a second.

Talk about productivity—the Cat power shift transmission delivers in a big way. Split-second on-the-go shifts give plenty of power in the highest gear possible. Shifting is so easy the operator just naturally gets more work out of the tractor. What's more, he gets it on the toughest, most demanding track-type jobs.

Besides the power shift transmission, you also have your choice of direct drive or torque converter in the D9 or D8. For complete facts on the new Cat power shift transmission see your Caterpillar Dealer. He's ready to explain in detail how it works, or to demonstrate its ruggedness . . . its ease of operation . . . its productivity. Name the date—he'll demonstrate!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

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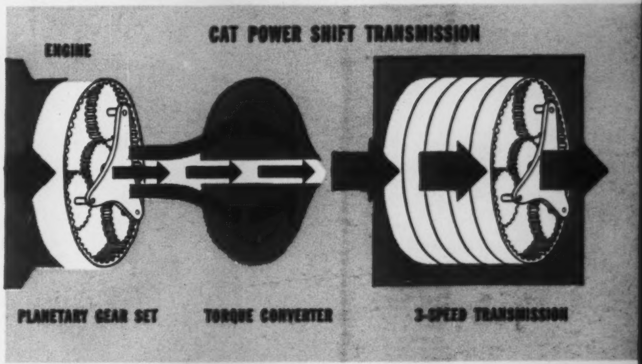
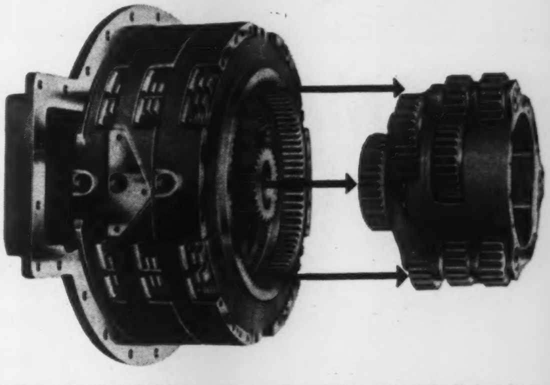
DIESEL ENGINES • TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

BORN OF RESEARCH
PROVED IN THE FIELD



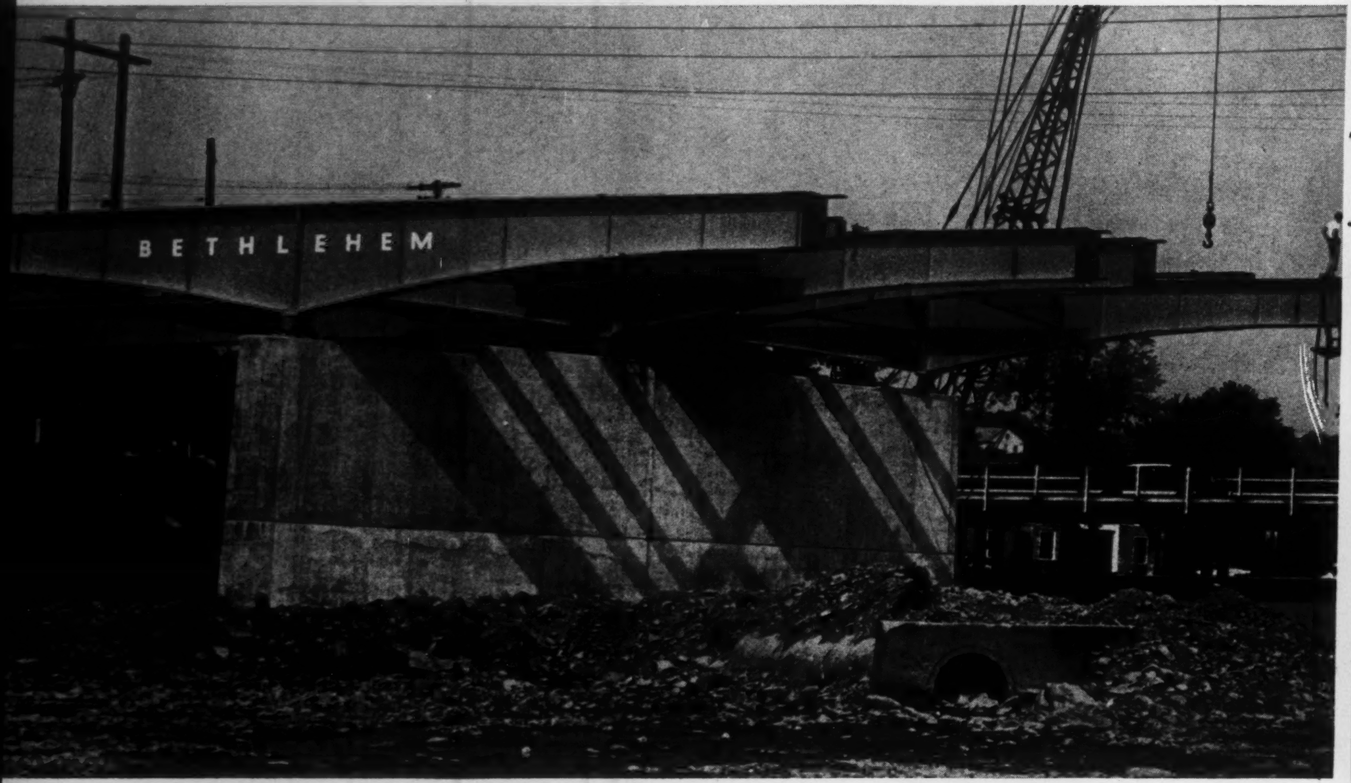
BASIC DESIGN: Total power is transmitted from the engine to a planetary gear arrangement mounted in the engine flywheel. The planetary divides and directs the total power—part goes through a direct drive shaft straight to the transmission and the remainder through a torque converter to the transmission. This enables the Cat power shift transmission to combine the snap and positive operating feel of direct drive with the anti-stall and flexibility features of torque converter drive. Its clean, unit construction design makes it easy to service, when required.



ONE TON OF RUGGEDNESS: Here's a portion of the components that make up the new Cat power shift transmission. Designed and built specifically by Caterpillar for its giant tractors, this rugged transmission weighs well over a ton. Every component is constructed for long-lived service. Selected alloy steel insures a transmission that stands up under the toughest conditions. Equally important, Cat power shift transmission comes to you thoroughly tested by exacting design and demanding field work in the heaviest earthmoving duty.

***CATERPILLAR'S NO. 1 PROJECT:** A multimillion-dollar research program—to meet the continuing challenge of the greatest construction era in history with the most productive earthmoving machines ever developed.

DESIGNING WITH Steel Saved



...and the superstructure went up in just

HOW WELL CAN STEEL BRIDGES DO IN COMPETITION WITH OTHER MATERIALS?

Just take a look at these facts and figures:

NOVEMBER 21, 1958—Pennsylvania Department of Highways accepted bids on a 350-ft-long, 4-lane dual highway bridge over Brodhead Creek between the boroughs of Stroudsburg and East Stroudsburg. The Department of Highways designed the bridge around the use of a competitive material, with an alternate for structural steel designs by the contractors, subject to approval by the Department of Highways.

Contract awarded to J. Richard Nissley, Inc., whose low bid is based on a superstructure bid of $300,000 for structural steel design by Bethlehem Steel. The only bid based on a design using competitive material was $402,000 for the superstructure. Steel design saved $102,000!

$102,000

The first steel was placed on June 3.

six working days!

Closing the Brodhead Creek bridge on June 10. The center girders measure 67 ft long and weigh 15 tons each. The main span is 150 ft; the two side spans 120 ft each. The girders are of welded construction, connected in the field with high-strength structural bolts. Total tonnage: 630 tons.

APRIL 4, 1959—Fabricating operations began at Bethlehem's Pottstown Works.

JUNE 1, 1959—First steel members shipped to the bridge site.

JUNE 3, 1959—Steel erection began.

JUNE 10, 1959—Closing members placed in 6 days!

JUNE 12, 1959—High-strength bolting operations completed. Bethlehem crew loaded out; general contractor took over.

FOR LOW COST, FOR FAST CONSTRUCTION, ALWAYS SPECIFY STEEL BRIDGES

BETHLEHEM STEEL

BETHLEHEM STEEL

R. D. WOOD GATE VALVE

THE R. D. WOOD GATE VALVE . . .
DESIGNED TO BE
BURIED AND FORGOTTEN

- So simple and sturdy that it lasts for generations
- Always ready to operate when needed
- Only 3 moving parts—the spreader and two discs

Available with conventional or "O" ring packings
Conforming to AWWA specifications

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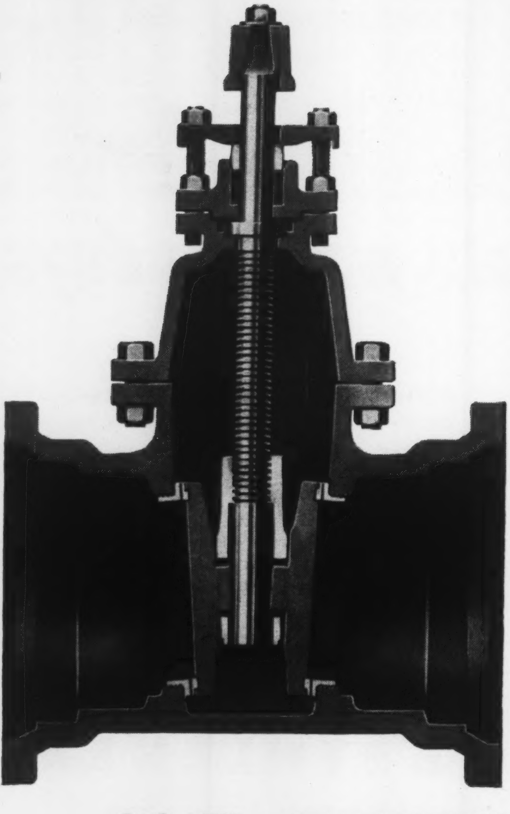
Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe
(centrifugally cast in sand molds)



THE WALL STREET JOURNA

VOL. CLIII NO. 21 ★ WASHINGTON, D. C., FRIDAY, JANUARY 30, 1959

Whoosh!
The 2,000-mph Airliner
Edges Closer to Reality
7 Firms Push Plans

Reprinted with permission of Wall Street Journal in the Engineers' interest

To put less money in the ground and more above in building design

Florida Church Builds On Sand—Despite The Gospel Warning

• • •

Proponents Say Vibroflotation Process of Packing Sand Cuts Need for Pile-Drivers

By ROBERT RAMAKER
Staff Reporter of THE WALL STREET JOURNAL

HIALEAH, Fla.—The First Methodist Church here has just built on sand—Gospel warning to the contrary.

But the Rev. Maurice Felton expects his spanking new, Spanish-mission-style church to endure the ages. The firm-jawed pastor is standing four-square on "Vibroflotation," a method that squeezes foundation sand together so tightly and permanently, its backers claim, that costly pile driving can be forgotten.

By using Vibroflotation the churchgoers here have trimmed foundation costs by $15,000—a tidy 7% of the total cost of $212,000, says Miami architect Dean Parmelee, who designed the church.

Others Turn to Process

Lured by such saving, others are turning to the new process. Schools, warehouses, airport hangars, silos, university buildings and highways are being built in more than a dozen states on sand compacted by Vibroflotation.

Rust Engineering Co., of Pittsburgh, which holds the patent on the process, says that its subsidiary, Vibroflotation Foundation Co., has handled a total of 60 projects thus far, most of them in the last two to three years.

To see how the process works, pour water into a pail of sand until the sand is saturated. Tap the side of the pail and the sand settles down. Much the same thing happens to a beach exposed to prolonged pounding by the ocean. The thoroughly-soaked sand attains speedway hardness.

While there is nothing particularly new about packing down sand, other methods pack from the surface. But Vibroflotation does its shaking and soaking beneath the surface—as deep as 62 feet. And Vibroflotation's proponents say that once compacted the sand stays packed, even after it dries.

To see the process in action, visit Florida's Pompano Beach, some 40 miles north of Miami. Here, rising above the scrub-strewn sand, you see a 50-foot crane from which is suspended the long, slender Vibroflot. Hanging tail-up, the Vibroflot—four stories high and only 15 inches in diameter—looks like an inverted missile. It's at work on a 340-foot by 146-foot site for Boward County's $1.6 million North District Hospital.

Settling the Sand

The needle-shaped compacter, armed with a water-squirting nose, plunges under its own three-ton weight into the soft sand, shaking its way 35 feet down. As the compacter shakes, the wettened sand settles. Slowly it's lifted up, and workers pour sand into the depression created by this big squeeze. The area squeezed tight is about two strides across. Again and again the compacter goes up and down—711 times to cover the area that needs settling, in this case.

Using it, the district has cut construction costs by $28,000 and achieved what the architect, William G. Crawford of Fort Lauderdale, believes is a comfortable safety factor under the four-story concrete block and stucco building.

Meanwhile, dozens of brawny workmen eight to ten feet down already are excavating for the foundation. They dig vertical sides yet hardly a grain of sand trickles in on them. A few yards away, sand is soft enough fo a playbox.

Taxpayers are getting a break from th cost-cutting propensities of this earth-burrowing "missile," its proponents claim. William Flynn, manager of the Pittsburgh company' subsidiary, said that piling at the recentl completed University of South Florida woulc have run $1 million. "With Vibroflots th cost came to $115,000," he says.

Building a Mill

Industry also is being attracted by the savings which Vibroflotation offers. Rayonier, Inc., for instance, used it in building its wood cellulose mill at Jessup, Ga., and across the continent at Attalia, Wash., Boise Cascade Corp. used it to prepare the foundation for its paper mill.

Given the right soil conditions, Mr. Flynn claims foundation costs can be reduced 50% on $15,000 to $25,000 jobs by Vibroflotation, and by more on larger ones. A factor in any saving is how deep the foundations have to be; if less than eight feet, pile-driving companies can do the job about as cheaply, he says.

While the Rust subsidiary has been working on the process for six years now, the early going was difficult. Mr. Flynn confesses that Vibroflotation Foundation Co. lost money its first three years. And the company's Florida representative, lean-faced, mustachioed Vincent Batz, recalls he thumped for Vibroflotation for three years before he landed a customer. Recently, however, the process has begun to win acceptance. "Last year we grossed about $500,000 and this year we've already got orders on the books totaling $750,000," says Mr. Flynn.

Besides shaving costs, Vibroflots are quiet, says another company official. He cites how the gentle swooshing of the Vibroflots in Palm Beach kept peace with the town's winter-season, anti-noise ordinance. Result: Foundation work for the four-story Park Place apartment unit was completed on schedule.

At Hampton Roads Crossing, a man-made island in Virginia, Vibroflots were used to compact the soil for the highway crossing it.

Thus far, Vibroflotation has had its greatest acceptance in the Deep South where in many cities most of the naturally-solid foundations sites are occupied, and businessmen and civic planners have to cope with building on sand. But Mr. Flynn is optimistic about developing business in other sections of the country.

Other builders have conflicting views about the Vibroflotation process. Says James T. Monahan, executive vice president of the Auchter Co., big heavy construction concern, of Jacksonville, Fla.: "It seems to work fine. For compacting soil it does an excellent job." But a representative of Raymond Concrete Pile Co. in Miami, says rather sourly, "Sure it works in special cases. But like any other tool it has its limitations."

So far, the process has proved too expensive to use on individual home sites.

Leafing through the company's record of successful jobs, a representative concedes to one goof. In 1956, the Vibroflots compacted a Port Everglades, Fla., site to stand up under six heavy industrial silos. The silos were built on top of 27 feet of compacted soil. But scarcely was the first silo loaded with cement when it tilted. Experts from Rust Engineering were hustled down from Pittsburgh. The cement was piled in a little differently and the silos have kept an even keel ever since, the company says.

While the company seems adept at saving others money, it admits to having problems with its own costs. "The process is great," beams a regional representative, "but moving a Vibroflot from one site to another is ex pensive. Even so, we're cutting down on this in-and-out cost. Using other people's electricity was a big item. Now we operate with our own generators."

a meeting of ...autical Sciences.

Conspicuous by their absence were representatives of two other big jet plane makers, North American Aviation, Inc., and Lockheed Aircraft Corp. Aviation industry officials generally figure North American and Lockheed

but they wouldn't be heard or felt to any great extent on the earth. Such a procedure would sharply boost fuel consumption. And it would have to be repeated on the way down.

What's more, to get off the ground, a 2,000-miles-an-hour transport probably would have to use afterburners—big tubes attached to the rear of jet engines and burning huge amounts of extra fuel to produce additional thrust. And an afterburner is one of the noisiest devices ever created, rivaling the rocket motors of big missiles.

The noisy afterburners at the least promise to create new problems for the airlines in getting permission to use big-city airports.

There may never be a solution to the noise

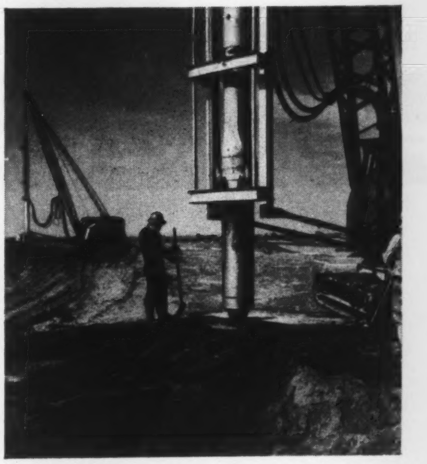
Please Turn to Page 17, Column 1

(Today's Index on Page 2)

is spending three days.

Please Turn to Page 17, Column 1

to step up research on ways to trap the air pollutants in auto exhaust.



The soil compaction job for the Boise-Cascade Corp. plant site proceeded at a rate of 4,000 cubic feet of soil compacted per hour with two Vibroflot machines. Each compaction consumed 3 or 4 tons of sand. Savings were about $35,000.

VIBROFLOTATION FOUNDATION CO.
930 FORT DUQUESNE BLVD. • PITTSBURGH 22, PA.

Write for
Booklet C-22

NEWS OF MEMBERS

Ronald M. White, for the past six years director of Aviation for Kansas City, Mo., has been appointed to a similar post at Dayton, Ohio. His connection with aviation in Kansas City goes back to 1932 when he planned and supervised the levee and drainage work for the Municipal Air Terminal. One of his major achievements since becoming aviation director was the construction of the Mid-Continent International Airport. He was president of the Kansas City Section.

George L. Lommel, engineer with the New York office of the Public Housing Administration, retired recently after twenty-four years of Federal service. Since 1957 he has been chief of construction and inspection of the New York Regional Office, which has jurisdiction over the low-rent program in New England, New York State, and New Jersey. During his government service, Mr. Lommel worked on construction of the Cape Cod Canal.

Robert C. Goodpasture has been appointed new business manager for McConathy, Hoffman & Associates, Inc., New York City, developers and designers of specialized research facilities for the aircraft, space-missile and related fields. Mr. Goodpasture was formerly associated with the H. K. Ferguson Company and Sanderson & Porter of New York in various engineering and sales development capacities.

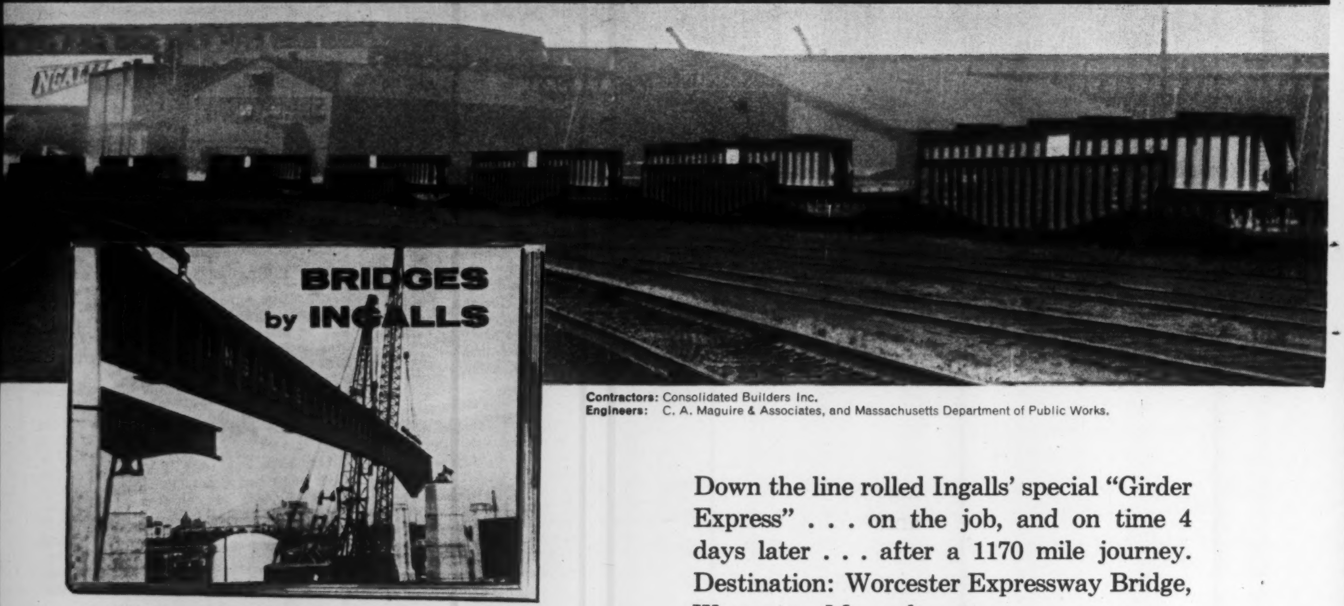
Roy T. Sessums, assistant vice president of the Freeport Sulphur Company, New Orleans, has been promoted to the rank of brigadier general in the U.S. Air Force Reserve and assigned to the Air Research Development Command, Air Force Missile Test Center, at Cape Canaveral, Fla. He is a former dean of the Louisiana Polytechnic Institute's School of Engineering and former director of the Louisiana State Department of Public Works. Mr. Sessums is a past president of the Louisiana Section.

Bertram S. Warshaw, structural designer with Morton R. Fellman, of Miami, Fla., has opened a consulting engineering office at 4361 Mayfair Drive, Miami, for the practice of structural, civil and architectural engineering.

Robert B. Hickok recently joined the Facilities Development Planning Corporation at Los Angeles, as vice president and technical director. For the past three years he has been with Holmes & Narver, Inc., in Los Angeles, as project engineer on selection and utilization planning of sites for Air Force ballistic missile installations, and before that was with the Department of Agriculture for twenty-three years on development and management research projects in the Midwest and Southwest.

Preston T. Bennett, who has a distinguished record of accomplishment in the field of soils mechanics, recently retired as chief of the geology, soils and materials branch of the Missouri River Division office of the Army Corps of Engineers. An original employee of the Missouri River Division when it was founded in 1934, he has had a basic role in the construction of all the dams being built upstream. Mr. Bennett plans to do consulting work and has been asked by the Corps to serve in that capacity. Mr.

16-CARLOAD "GIRDER EXPRESS"



Contractors: Consolidated Builders Inc.
Engineers: C. A. Maguire & Associates, and Massachusetts Department of Public Works.

FREE Write for this new, fully-illustrated brochure featuring bridges by Ingalls.

Down the line rolled Ingalls' special "Girder Express" . . . on the job, and on time 4 days later . . . after a 1170 mile journey.
Destination: Worcester Expressway Bridge, Worcester, Massachusetts.
Cargo: 32 Ingalls' steel fabricated bridge girders – each 93′ 3″ in length.

Bennett was a United States representative at the World Conference on Large Dams in India in 1951.

A. H. Barber, Jr., has been made senior vice president of Walter Hook Associates, Inc., architects and engineers, of Charlotte, N. C., after fourteen years with the firm. For many years, prior to joining Walter Hook Associates as chief engineer, Mr. Barber served with the Corps of Engineers as engineer officer, company commander, and battalion commander.

Henry A. Babcock, assistant professor of civil engineering at the Colorado School of Mines, has been advanced to associate professor. Mr. Babcock, a Mines faculty member since 1946. has also acted as a consulting engineer.

Gene N. Burrell recently received a twenty-year service pin from the Corps of Engineers. Mr. Burrell, who is in charge of sedimentation engineering for the Corps at Fort Worth, Tex., has completed a study of Whitney Reservoir after eight years of operation and has investigations underway at Waco, Canyon, Proctor, McGee Bend, and Navarro Mills reservoirs.

M. J. Naughten retired on July 31 from the Kaiser Steel Corporation in Fontana, Calif. At the time of his retirement he was safety director.

Steven L. Fortunato was sworn in July 8 as a new member of the Wilmington Regional Planning Commission. Mr. Fortunato is an architectural engineer and is in the construction business with his brother in a firm started by their father, Luigi Fortunato.

Emil Hargett, until recently a professor at the University of Florida, has joined the faculty of South Dakota State College, where he will be in charge of highway engineering instruction as well as teaching soils engineering. **Marshall Anderson** also is a recent addition to the South Dakota State College staff. He goes from the University of Arizona, where he was an instructor, to the position of assistant professor.

Fernando Castro, formerly principal mechanical design engineer with the Puerto Rico Water Resources Authority, San Juan, is now connected with Burns & Roe, Inc., with headquarters in New York. Mr. Castro's thirty-year career includes work on hydroelectric and steam power developments, marine engineering, and hull and ordnance work on naval vessels.

John C. Rehfield, has established an editorial consulting office at P. O. Box 1299, Lake Wales, Fla. Offering public relations, field reporting, and photography services in the engineering and construction fields, Mr. Rehfield will concentrate his efforts in the Southeastern states. He was formerly on the Technical Publications staff of ASCE, and more recently served as executive editor of Construction Equipment Magazine.

Moseley Collins, of Clearwater, Fla., has been named Sarasota County engineer. In his new post, Mr. Collins has charge of the road and bridge program as well as the building department. He was previously associated with the E. A. Mariani Asphalt Company in Tampa and Clearwater.

Samuel F. Stephens, construction controls engineer for the Virginia Department of Highways at Richmond, has retired after twenty-nine years of active service. From 1942 until 1958 Mr. Stephens was contracts engineer for the department.

Rush A. Kelso, formerly division engineer with the Southern Railway Company in Atlanta, Ga., has resigned to enter the real estate business. Mr. Kelso first joined Southern Railway in 1942 and in 1950 was promoted to division engineer.

(Continued on page 24)

FROM INGALLS

Transportation of the huge girders required 8 heavy-duty flat cars and 8 of the longest gondolas in normal use.
Whether your next job calls for a carload or a trainload of fabricated structural steel . . . you're on the right track for first-class service, express deliveries, and economy rates when you call – Ingalls.

STEEL PLATE FABRICATORS ASSOCIATION FOUNDED 1933

AISC

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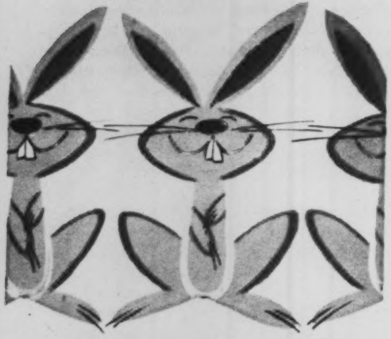
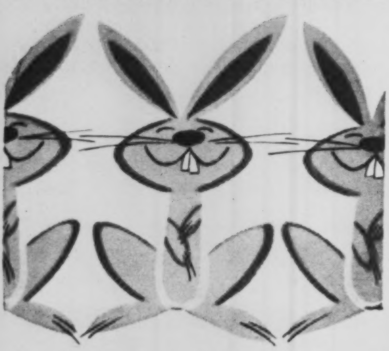
INGALLS
IRON WORKS COMPANY
Executive Offices
BIRMINGHAM, ALABAMA

The difference in



MICROTOMIC
DRAFTING LEADS



is that they're all alike!

The point is—a Microtomic 2H is a 2H is a 2H . . . regardless of where or when it was purchased.

The consistent uniformity of degree in MICROTOMIC Leads is one direct result of EBERHARD FABER's pencil quality control which also results in unusual point strength . . . sharper, blacker lines. They're *sure-fired*—at 10,000 degrees F.—for smooth drafting! In 17 *consistently graded* degrees . . . one dozen to flip top box with handy point sharpener. Use with MICROTOMIC Lead Holder. You'll agree it has a grip that's great!

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110th Anniversary, 1849—1959

EBERHARD FABER

WILKES-BARRE, PA. • NEW YORK • TORONTO, CANADA

News of Members

(Continued from page 23)

Donald N. McCord has been promoted from construction manager for Stone & Webster Engineering Corporation to vice president of the engineering and construction organization, with headquarters in Boston. Mr. McCord is now in charge of the firm's construction in the Pacific Northwest, including the Rocky Reach hydroelectric project on the Columbia River and the Baker River Power Project for Puget Sound Power and Light Company of Seattle, Wash.

Richard O. Albright, new field engineer for the Portland Cement Association, will represent the Association in northwestern Indiana. He has been a designer for the past five years for Clyde E. Williams & Associates, of South Bend, Ind.

John A. Ziemian, Jr., has been selected by the Linden, N. J., city council as city engineer to fill an unexpired term which ends December 31, 1960. For ten years he has specialized in road and highway design, and supervised road construction as an employee of Porter, Urquhart, McCreary & O'Brien, consulting engineers, of Newark, N. J.

Leon Hershkowitz became assistant dean of the faculty of the University of Missouri's School of Mines and Metallurgy on September 1, replacing **Vernon A. C. Gevecker,** who will return to teaching duties as professor of civil engineering. Professor Hershkowitz has been on the teaching staff there since 1946. He is immediate past-president of the Mid-Missouri Section.

Arthur C. Andrews and **Erwin R. Bretscher,** consulting engineers, announce the opening of their office, Andrews and Bretscher, for the practice of civil and structural engineering. The new firm will be located at 413 Terrace Place, Terrace Park, Ohio.

Stefan J. Medwadowski, consulting structural engineer, announces the opening of a San Francisco office at 111 New Montgomery. The firm's East Bay office will continue to be located at 1722 Walnut, Berkeley, Calif.

Carl E. Vogelgesang was named "Engineer of the Year" at a recent convention of the Indiana Society of Professional Engineers. Mr. Vogelgesang has been associated since 1921 with the Indiana State Highway Department, where he is currently chief engineer. He is a past president of the Indiana Section. Honored as "Junior Engineer of the Year" was **Lowell B. Jackson,** an instructor in civil engineering at Purdue University. Mr. Jackson is also studying for a master of science degree.

Alan C. Carter, since 1953 field engineer for the Portland Cement Association at Salt Lake City, Utah, succeeded **Ralph E. Spears** as the Association's Salt Lake City district engineer on August 15. In the meantime, Mr. Spears had taken over duties as regional structural engineer for the West Central Region.

Vincent J. Roggeveen, a specialist in engineering administration and transportation, is leaving the post of assistant professor and assistant director of highway research at the Massachusetts Institute of Technology to become associate professor of civil engineering at Stanford University. **William Weaver, Jr.,** a recent recipient of the Sc.D. degree from MIT where he was associated with the Lincoln Laboratory, has been named assistant professor at Stanford.

Max Bookman and **R. M. Edmonston,** supervising hydraulic engineers for the California State Department of Water Resources at Los Angeles, have resigned to go into private practice in Glendale, Calif. Mr. Bookman has been engineer in charge of the Southern California district, and Mr. Edmonston has recently completed route surveys for the Feather River Project.

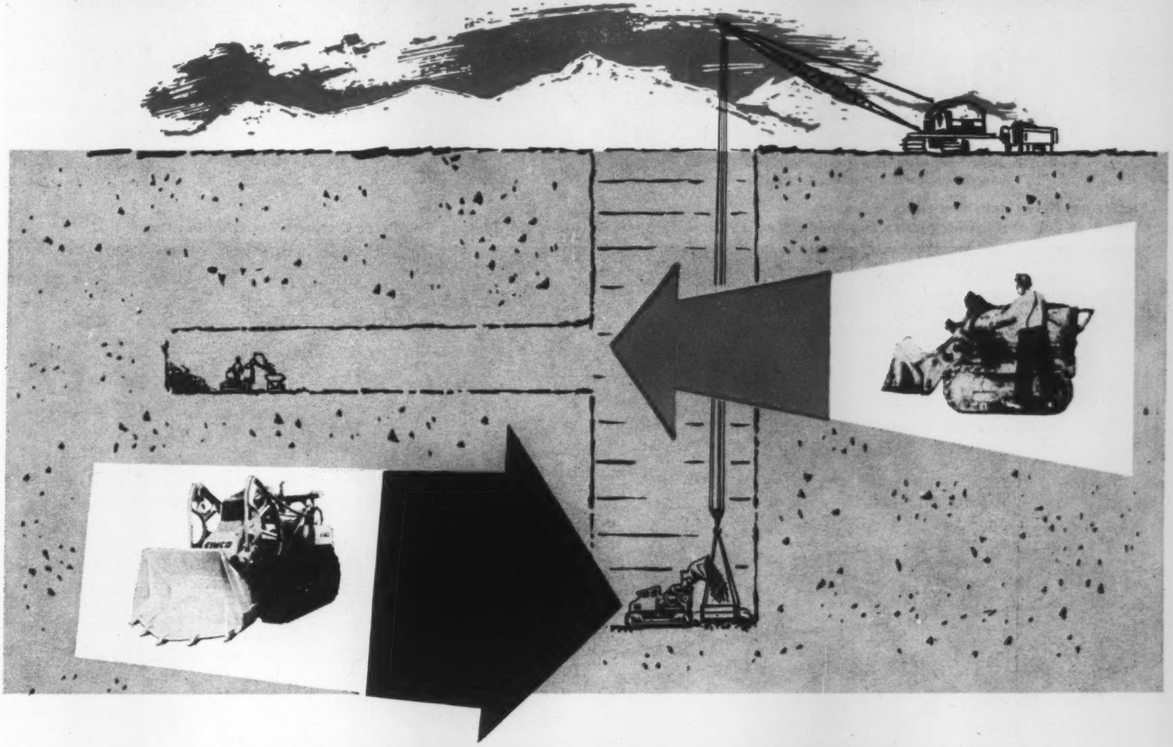
William B. Jameson, assistant works manager of the Bethlehem Steel Company's fabricating works in Torrance, Calif., has been named works manager. Mr. Jameson has been connected with the company since 1949 serving as field engineer on the four-mile-long Chesapeake Bay Bridge and as project engineer for the new fabricating works in Torrance.

O. F. Sorgenfrei and **W. F. Farnham** have been accepted into partnership in Modjeski and Masters, consulting engineers of Harrisburg, Pa. Mr. Sorgenfrei has been associated with the firm in various design and supervisory capacities since 1937, while Mr. Farnham has been associated with the firm since 1948. Named as Associates of the firm are **T. R. Kealey,** a member since 1947, and **F. M. Masters, Jr.,** a member since 1951.

Clarence A. Vicklund, formerly supervisor of the general engineering technical group of the Creole Petroleum Corporation in Maracaibo, Venezuela, has recently been transferred to the company's Caracas office as head of civil engineering. Mr. Vicklund is in his eleventh year with Creole, an affiliate of Standard Oil of New Jersey.

(Continued on page 122)

Economical, Efficient Construction of Missile Base and Launching Sites



On-The-Job Proven Solutions with the Eimco 105 and 630 Lines of Loaders

As the nation undertakes the building of underground ballistic missile complexes, American industry and ingenuity has already made available the specialized equipment necessary, and proven their efficiency in use.

Private enterprise has had to strive for utmost efficiency for low cost and large output in tunneling and excavating, both vertically and horizontally. Thus, when A. J. Cheff Construction Company won the subcontract for underground tunneling and shafts involved in the sinking of the Swift Creek 55 foot circular spillway and control shaft, they turned to a modern Eimco 105 Crawler-Tractor Excavator to do the job. The shaft was sunk to a depth of 950 feet, using one 105 excavator for all loadings of broken material from the shaft bottom.

The machine was lowered to the bottom onto the newly-blasted rock by an 80 ton mobile crane. The same crane was then used to lower and, after loading, hoist, a truck dump bed. Broken material was loaded on the shaft bottom by the Eimco 105, digging its way into the broken rock. Upon being hoisted, the dump bed load was dumped by swinging it into position over a Euclid truck, the "tag" line of the crane being used for dumping.

In shale, an Eimco 105 specially engineered short-coupled dozer with ripper attachment has been successfully used and in underground rooms, the excavator loads directly into a truck bed, carried on a flat-rack truck. Even in such tough assignments, the Eimco 105 excavator, which is diesel powered, showed a mucking rate as high as 125 cubic yards per hour!

In tighter areas, Eimco's famous 630 underground mining excavator, running on compressed air or AC or DC current, has proven its capabilities all over the world. With a production rate of 40 cubic yards per hour for the 630, production with either of these machines is limited only by the hoisting capacity available. The Eimco 126 Front End Loader has also proven itself as an efficient tunneling unit.

Thus, the combination of Eimco engineering and production knowledge and progressive construction company practices, has developed proven-on-the-job solutions to economical construction of intricate ballistic missile complexes and similar projects. For further facts, data and courteous, qualified consultation, write The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah.

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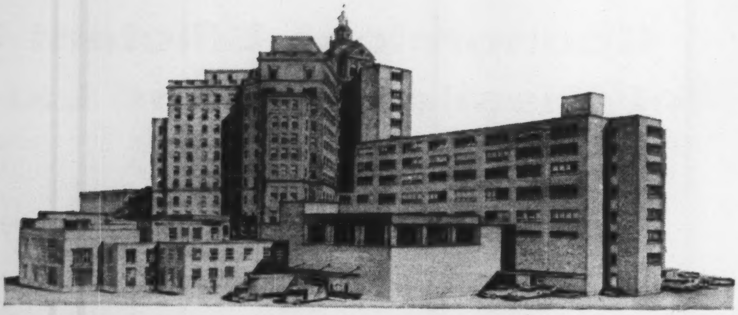
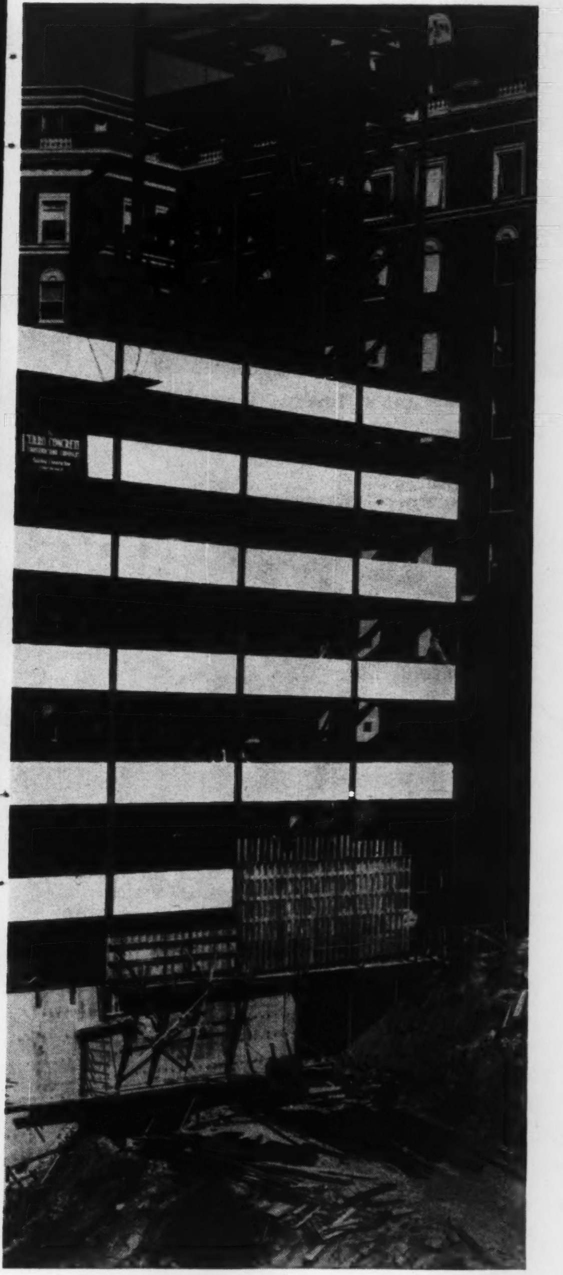


The Christ Hospital in Cincinnati with new wing shown at the right. This is one of the first to use USS TRI-TEN High-Strength Low-Alloy Steel columns to reduce over-all size and cost.

Architects: Harry Hake and Harry Hake, Jr.
Consulting Engineers: Harry Balke Engineers. Steel Fabrication: Indiana Bridge Co. Builder: The Ferro Concrete Construction Co.

High Strength Steel Columns save space and 50 tons of steel



Often terrain and available space limit over-all building size. In the case of this hospital, it was desirable to keep over-all size of the new wing to a minimum and costs as low as possible. USS TRI-TEN High-Strength Low-Alloy Steel wide-flange beams solved both problems.

According to Harry Balke Engineers: "Any savings in depth of the column sections could be reflected directly in the over-all width of the hospital. A savings in depth of column was therefore multiplied 4 times. By using A242 steel (USS TRI-TEN Brand), columns were restricted to 16"x16" maximum width and depth. With A7 steel, the building width would have been 8" wider, adding approximately 1600 square feet of unwanted area, over half of which would be unusable. Approximately 50 tons less steel was required for the columns than would be required with A7 steel and, of course, savings resulted in the substructure as a result."

USS TRI-TEN Brand Steel has a minimum yield point o 50,000 psi—about 50% greater than structural carbon steel. It results in slimmer columns and, in turn, more useable floor space, or smaller exterior building size.

Good weldability. USS TRI-TEN Steel can be readily welded with the usual shop methods. In this building all shop connections were welded, and field connections bolted with high-strength bolts.

When designing a new building or any large structure, investigate the money-saving advantages of USS Special Steels. These include three brands of high-strength steel with minimum yield points of 50,000 psi—USS TRI-TEN, COR-TEN, and MAN-TEN. Where exceptionally high strength is needed, USS "T-1" Constructional Alloy Steel with a minimum yield strength of 100,000 psi will frequently solve a tough problem. For information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS, TRI-TEN, MAN-TEN, COR-TEN and "T-1" are registered trademarks

New color movie available—"Challenge at Carquinez." A 27-minute, 16mm. color film showing the design and construction of the unique Carquinez Strait Bridge. Ideal for engineering groups. For booking information, write United States Steel, Pittsburgh Film Distribution Center, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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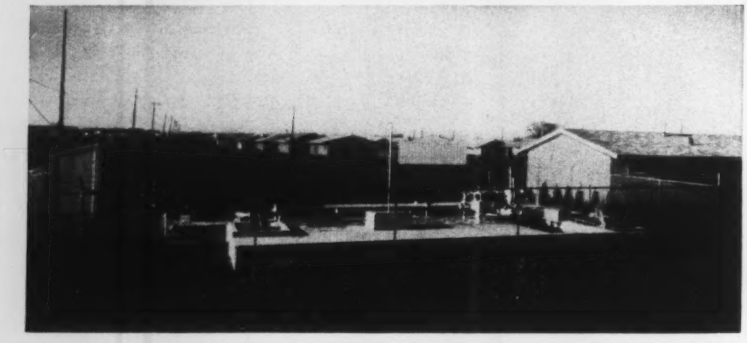

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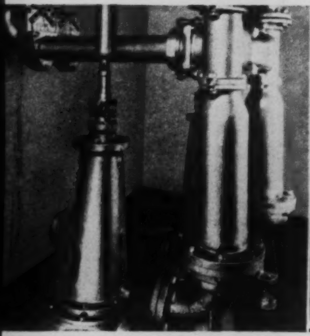
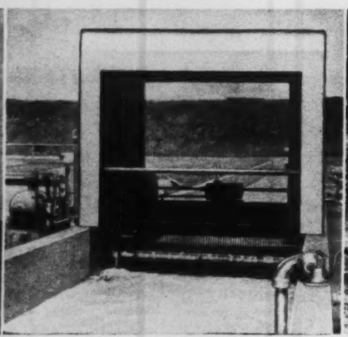


FLUSH-KLEEN® Sewage Pumps — never clog! Solids never reach the impeller. More than 13,000 installations.



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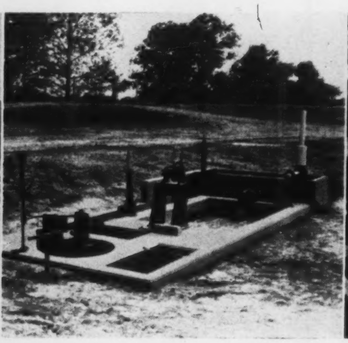

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. . . . . Am-Soc Briefs

▶ ▶ Last call for the Convention. . . . A final reminder that Annual Convention time is almost here. This year the Convention will be held in Washington, October 19-23, against the backdrop of another spectacular Civil Engineering Show, only the third in ASCE history. One of the interesting Convention features will be the induction of new officers, presentation of honorary memberships, and the annual award of Society prizes. Biographies of these famous folk are in the Society News section of this issue. . . . In case it was overlooked, the Convention program was in the September issue.

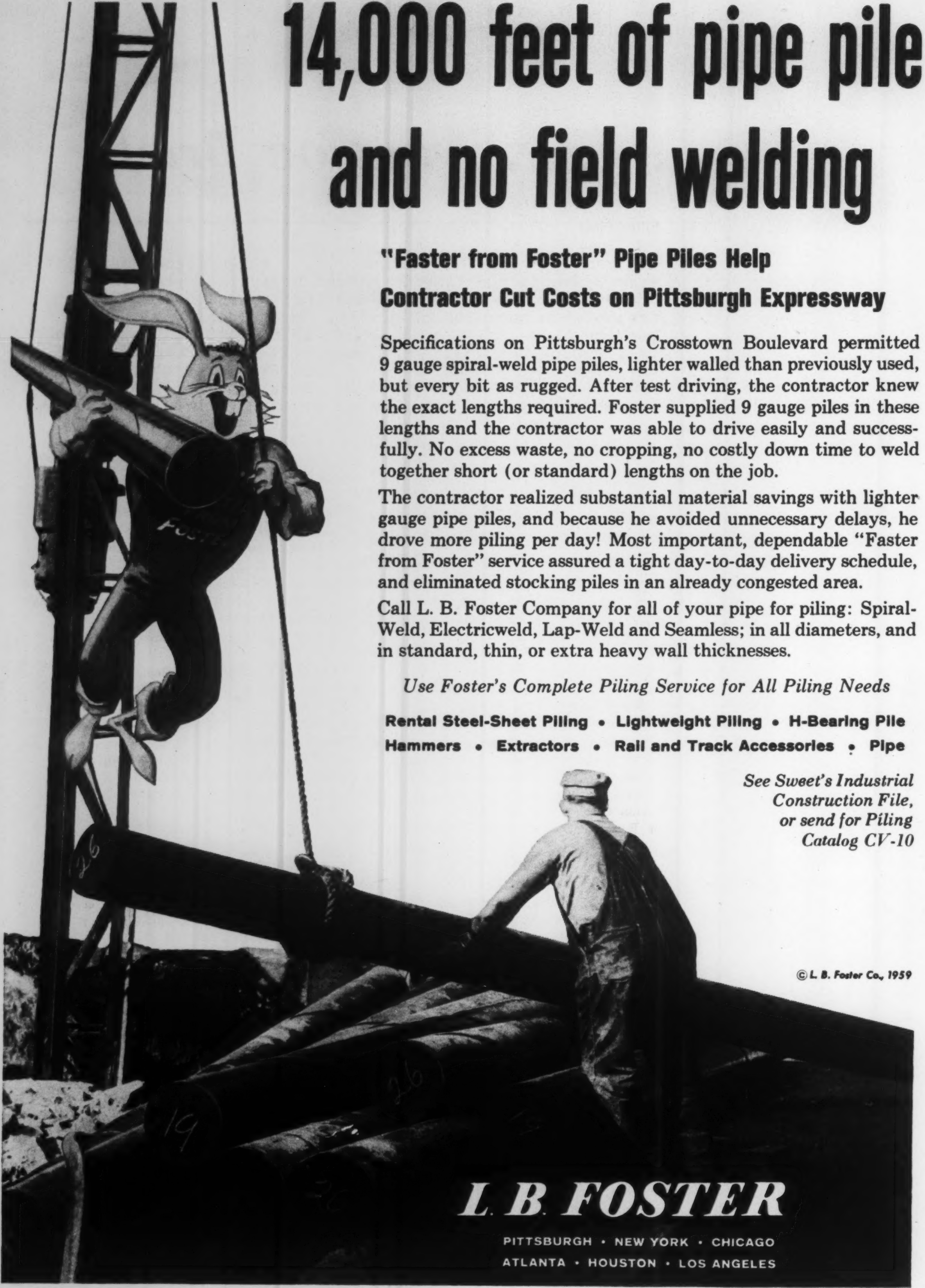
▶ ▶ Groundbreaking for the UEC. . . . The big news in the campaign for the United Engineering Center is that groundbreaking has been definitely set for October 1. The event of a lifetime, the ceremony will come in the midst of an intensive campaign to finish the drive for funds. Member giving is still 13 percent shy of its goal. ASCE has subscribed 72 percent of its quota, though the majority of its members are still to be heard from. . . . This issue carries a full-color artist's rendition of the beautiful new Center.

▶ ▶ ASCE Salary Index. . . . The ASCE Salary Index changes this month. It will be noted (page 84) that pay rates for civil engineers are up in nine of fifteen U.S. cities. Similar trends are seen in five of six major geographical regions. Only one reversal is noted. This occurs in Region I, which encompasses the New England states. These observations are based on analyses of data provided semiannually by a picked group of respondents (consulting firms and highway departments).

▶ ▶ More about civil engineering salaries. . . . Free copies of the "1959 ASCE Biennial Salary Survey" are now available upon application to ASCE headquarters. A digest of the report, published in the August issue of Civil Engineering, showed salaries for civil engineers up 6.2 percent over 1957. The full salary report was published as a Proceedings paper in the September issue of the Journal of Professional Practice. Ask for Proceedings Separate No. 2188.

▶ ▶ Research Fellowship open. . . . The ASCE Research Fellowship, which was established in 1958 by the Board of Direction for the purpose of stimulating the creation of knowledge that will advance the profession of civil engineering, is open for 1960. Applications for the $5,000 grant must reach the Executive Secretary of ASCE before January 1, 1960. Six copies are required. Inquiries will be answered by the Executive Secretary.

▶ ▶ The October edition of 50,200 copies marks the first issue in Civil Engineering history that has reached 50,000-copy status. It couldn't happen more fittingly, as the October issue also marks our 29th anniversary. The print order for the first issue of Civil Engineering, which made its bow in October 1930, was for 16,500 copies.



14,000 feet of pipe pile and no field welding

"Faster from Foster" Pipe Piles Help Contractor Cut Costs on Pittsburgh Expressway

Specifications on Pittsburgh's Crosstown Boulevard permitted 9 gauge spiral-weld pipe piles, lighter walled than previously used, but every bit as rugged. After test driving, the contractor knew the exact lengths required. Foster supplied 9 gauge piles in these lengths and the contractor was able to drive easily and successfully. No excess waste, no cropping, no costly down time to weld together short (or standard) lengths on the job.

The contractor realized substantial material savings with lighter gauge pipe piles, and because he avoided unnecessary delays, he drove more piling per day! Most important, dependable "Faster from Foster" service assured a tight day-to-day delivery schedule, and eliminated stocking piles in an already congested area.

Call L. B. Foster Company for all of your pipe for piling: Spiral-Weld, Electricweld, Lap-Weld and Seamless; in all diameters, and in standard, thin, or extra heavy wall thicknesses.

Use Foster's Complete Piling Service for All Piling Needs

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do you know that

Philadelphia's new Torresdale Filter Plant is push-button operated? The $25 million installation, which went into operation at the end of September, is the second largest water works in the country and the biggest automatically programmed plant, according to Water Commissioner Samuel S. Baxter. With maximum capacity of 423 mgd, the plant will supply more than half of Philadelphia with purified Delaware River water. The Torresdale Plant is part of a $123 million program to modernize the Philadelphia water system. By 1962 two other push-button units will be in operation.

■ ■ ■

Work is being rushed on the world's longest highway tunnel? When completed in 1961, the 7.5-mile Mont Blanc Tunnel will provide an all-season connection between France and Italy under Europe's highest mountain. It will shorten the present Paris-Turin trip by 137 miles and the Paris-Milan trip by 194 miles. The $30 million project is one of seven Alpine highway tunnels, currently under construction or planned to link Italy with France, Switzerland, and Germany.

■ ■ ■

Highway construction costs are down? The drop of 2.7 percent in the second quarter of 1959, the largest quarterly decrease since 1954, is in marked contrast to the 0.6 percent increase in the Bureau of Labor Statistics consumer price index, during the same period. However, the sizable decline does not necessarily indicate a downward trend in highway construction costs, according to Federal Highway Administrator Bertram D. Tallamy.

■ ■ ■

The U.S. needs to spend about $171 billion on water resources by 1975? This is the investment in water that will be required to keep abreast of population growth, industrial expansion, and higher living standards, as the Business and Defense Services Administration sees it. Another $60 billion will be required merely to offset obsolescence. If these expenditures are made, it will mean spending in a decade and a half as much as the country has invested in water resources and developments since 1790. The U.S. water picture is summarized in a report, entitled "Water Resources Developments Capital Investment Values 1900-1975," for sale by the U. S. Government Printing Office at 10 cents a copy.

■ ■ ■

There is a critical shortage of sanitary engineers? Only about 150 sanitary engineers are graduating from college each year, and yet each year in the next decade the nation will need over 900 additions to the field. This warning was delivered at the 1959 annual meeting of the American Society for Engineering Education by Frank A. Butrice, of the U. S. Public Health Service, and Prof. George W. Reid, of the University of Oklahoma. The sanitary engineering field is "loaded with potential," they said, especially for those with backgrounds in such new fields as radiological health and air pollution.

■ ■ ■

Panama Canal capacity is being increased? To meet new demands on the Canal, the Panama Canal Company is undertaking an improvement program that will increase its transit capacity by 25 percent. Already underway is the widening of the channel in the southern portion of the Gaillard Cut from 300 to 500 ft. The number of vessels using the Canal has increased from about 6,000 a year before the war to an anticipated 10,000 in 1959. Today's huge tankers and ore ships, which slow up operation of the canal by being too large for multiple lockings, are another reason for the improvement program.

■ ■ ■

The problem of careless drivers may be solved by driverless cars? At a recent convention of the Institute of Radio Engineers, the Westinghouse Electric Company suggested the use of strips of aluminum foil or special metallic paint on the highways, which cars would follow by means of built-in radar devices. All control functions would be handled automatically. The radar device could be installed under the hood or behind the grill of any automobile for $250.

■ ■ ■

A few of the Fifth Nuclear Congress papers are still obtainable? The list of papers available, at 50 cents each, may be obtained from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. EJC was the coordinating agency for the big congress, which brought representatives of thirty professional societies and industries to Cleveland last spring for exchange of information on the building and operation of nuclear plants.

■ ■ ■

Engineering feats are being given increased recognition on postage stamps? They are invading a field once the domain of palaces, monuments, forts, and churches. The first engineering project depicted on a U. S. postage stamp was the Mississippi River Bridge at St. Louis in 1898. More recent U. S. commemorative stamps have shown Grand Coulee Dam (1952), the Mackinac Straits Bridge (1958), and the Atlantic Cable (centenary in 1958). The ASCE centennial stamp (1952) is one of several that have honored national professional societies. In October the Territory of Aruba in the Netherlands West Indies will issue a stamp celebrating completion of the world's largest process plant for salt-walter conversion.

. . . familiar HIGH SIGN

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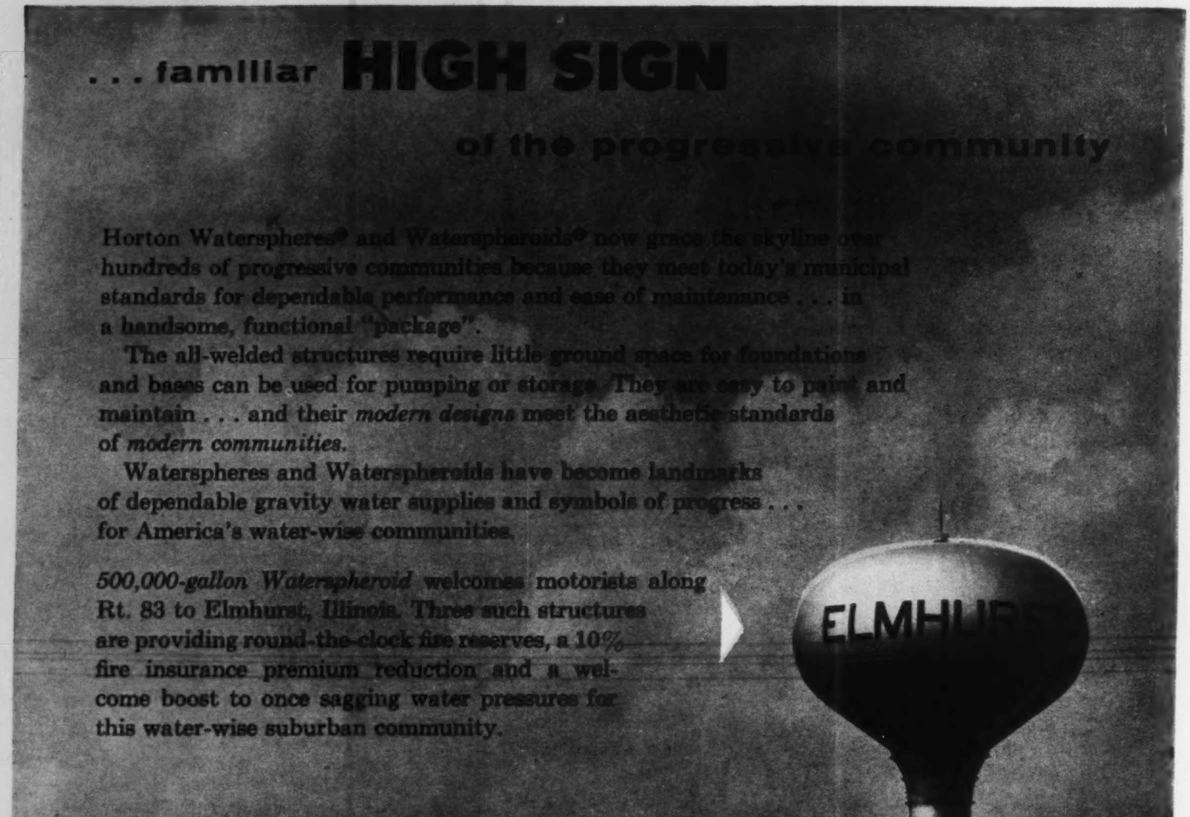
Horton Waterspheres® and Waterspheroids® now grace the skyline over hundreds of progressive communities because they meet today's municipal standards for dependable performance and ease of maintenance . . . in a handsome, functional "package".

The all-welded structures require little ground space for foundations and bases can be used for pumping or storage. They are easy to paint and maintain . . . and their *modern designs* meet the aesthetic standards of *modern communities*.

Watersphere and Waterspheroids have become landmarks of dependable gravity water supplies and symbols of progress . . . for America's water-wise communities.

500,000-gallon Waterspheroid welcomes motorists along Rt. 83 to Elmhurst, Illinois. Three such structures are providing round-the-clock fire reserves, a 10% fire insurance premium reduction and a welcome boost to once sagging water pressures for this water-wise suburban community.



Watersph*eroids* are built in capacities of 250,000 to 500,000 gallons. *Waterspheres* serve in range of 25,000 to 250,000 gallons. Write the nearest CB&I office for literature.

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CIVIL
ENGINEERING

Progress . . . and challenge

OTIS D. GOUTY, A.M. ASCE

Assistant to the Secretary, ASCE

New York, N. Y.

Last June's graduating civil engineers have now entered the field of practical engineering. They have been replaced in the colleges by advancing classes and new freshmen. All of these young people need continuing encouragement and indoctrination from practicing engineers to guide them into a professional way of life.

ASCE has cause to be proud of its record in this area of professional activity. This past summer about 2,650 new members came into the Society from a total of 4,750 graduates in civil engineering from schools with ECPD-accredited curricula—or about 56 percent. This percentage is larger than the proportion of graduates joining other engineering societies but it is not high enough to permit complacency.

The first step in developing interest in ASCE is at the Student Chapter level. Here embryo engineers get their indoctrination in the tenets of their chosen profession. They learn the principles of ethics and professionalism from dedicated professors and interested practicing engineers. Society members can help by voluntarily attending Student Chapter meetings, by assisting the students in obtaining qualified and challenging speakers, and by inviting student groups or individuals to visit their design office or job.

How effective is the Student Chapter program in accomplishing the purposes for which it was established? Just as it is difficult to determine the full effect of an advertisement in a magazine, so it is with regard to stating specifically the effectiveness of a program that is dependent on so many intangibles as ASCE's Student Chapter activities.

During the past school year there were active in the Chapters about 45 percent of those eligible for membership in these groups. That is, out of a total of 25,491 students studying civil engineering in the colleges and universities of accredited standing, 11,200 were members of ASCE Student Chapters. This includes entering classes, with many students who have not yet selected their engineering specialty or developed a professional interest. This percentage, like that given above, is generally higher than the corresponding percentages in other branches of engineering.

The fine ASCE record of student interest is due largely to a comparatively small group of dedicated members. Many Faculty Advisers of the Student Chapters, Contact Members from the Local Sections, and student officers put considerable effort into their Chapter work. But the effectiveness of the overall program is limited to the effort of those who are able and willing to give freely of their time. In the interest of greater professional consciousness among future members of the profession, every ASCE member should lend his wholehearted support to the Student Chapter program.

Engineering graduates need special encouragement to continue ASCE activities. One of the most effective means of doing this is for members to take these young people with them to Local Section meetings. No one enjoys meeting an unfamiliar group alone. Newcomers should be introduced to the officers of the Section and to their fellow engineers. A special effort should be made to meet and welcome new members into the group. In this way a stranger will be made to feel at home and at the same time he may develop long-lasting professional contacts.

Employers or supervisors have exceptional opportunities to instill the idea that Society activity is viewed favorably. The interest of employees in technical and professional development can be increased by encouraging attendance at regional conferences and national meetings of engineering societies. The Annual Convention of ASCE in Washington, D. C., October 19 to 23, is the place to start.

CONCRETING THE FORT PITT TUNNELS

JAMES O. IRWIN, Project Manager

Merritt-Chapman & Scott Corporation

New York, N. Y.

Concrete with 1¼-in. crushed limestone aggregate was made sufficiently workable by an admixture and air entrainment so that it could be blown 120 ft to line the Fort Pitt Highway Tunnels, which will provide a new approach to Pittsburgh's Golden Triangle. These twin tunnels pierce Mount Washington on the south bank of the Monongahela; they come out to the river in the face of a sheer cliff to connect with the double-deck Fort Pitt tied-arch bridge. The new facility is part of the Interstate system, and the Federal Government is contributing 90 percent to Pennsylvania's 10 percent of the estimated $16 million cost.

The parallel tunnels are at 60-ft centers. Each has two 11-ft 6-in. roadways plus curbs and a 2-ft 9-in. sidewalk. See Fig. 1. Tunnel length is 3,435 ft. The two tubes were excavated simultaneously from one end only, a 50-ton Mack off-highway hauler being used to mount a drill jumbo that was used alternately in the two bores. Tunnel advance was about three 8-ft rounds per day in each of the headings. More than 4,000 tons of steel supports were used, with post and arch assemblies set at 4-ft centers and steel lagging placed between. Verticals were 8-in. WF 31, and arches were 8-in. WF 40 sections.

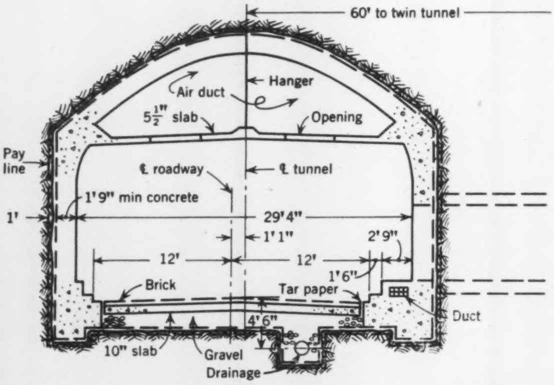
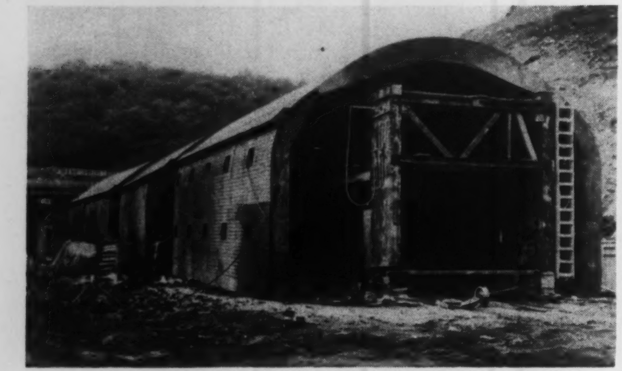


FIG. 1. Section through one of the Fort Pitt Tunnels. These tunnels will speed traffic from the east and south into Pittsburgh's Golden Triangle.

Blaw-Knox forms were pulled in and down on rail-mounted jumbo for movement under previously erected forms to next position in tunnel.

Press-weld pneumatic placer shoots Pozzolith concrete as much as 120 ft. through a 6-in. line to fill forms for tunnel lining.

Wires welded to outside of tunnel form roughened the surface to hold wall tiles. Projection at the arch spring-line provides a shelf on which the ceiling slab will rest.



About 61,000 cu yd of concrete was used in the roadways, tunnel lining, and the 5-in.-thick ceiling, which is at a height of 14 ft. The roadway is a 10-in.-thick reinforced concrete slab placed over a 12-in. granulated slag base. A brick surface goes over this.

The roadway concrete was placed in advance of tunnel lining. Steel paving forms were set in the conventional manner with the pins driven into the compacted slag base. One 11-ft 6-in. lane was concreted at a time, leaving the other lane open for concrete haul and a work area.

Concrete for the tunnel was batched into transit-mix trucks at the plant of the Marion Coal and Supply Co., three miles from the tunnel portal. Material was handled through a completely new double set of Heltzel four-compartment bins, batch selectors and weighing equipment. The Pennsylvania Department of Highways prohibits mixing while in transit. Water was added at the site and the concrete mixed for five minutes after the trucks backed into the tunnel to discharge directly on the subgrade. A fleet of four 6-cu yd, three 7-cu yd, and three new 9-cu yd high-discharge Jaeger mixers could deliver up to 600 cu yd of concrete in eight hours. A Blaw-Knox spreader and a finisher of the same make were used in the tunnel.

Having the roadway paved was a great help in tunnel lining. Forms were moved on a frame traveling on rails laid on the slab. Reinforcing was placed and concrete handled from a steel frame moved on the same rails. Concreting was started at the cliff end of the tunnels and moved toward the land portals.

Three sets of telescopic Blaw-Knox sidewall-arch forms, each 50 ft 4 in. long, were moved by a single jumbo on rails spaced 12 ft 10 in. apart. Hydraulic jacks pulled the bottom of the form in while others lowered the jumbo to permit the assembly to pass under the units in use.

Concrete trucks were backed into the tunnel and discharged on an inclined conveyor, which carried the concrete to the 1⅛-cu yd hopper of a Press-weld pneumatic placing machine. Using compressed air, this unit shot the limestone aggregate concrete, made workable by the addition of Pozzolith, a distance of up to 120 ft, compacting it into the tunnel forms.

About 400 cu yd of concrete was required to fill a 50-ft section of form. Placing at the rate of 1⅛ cu yd per min made it possible to fill the form in about six hours. The placer unit was moved back as concreting progressed, pulling out the slick-line pipe as concrete was compacted. This pipe had an inside diameter of 6 in.

Specifications required 3,000-psi concrete made with Type 1A, air-entraining portland cement, a maximum of 5 gal of water per sack of cement, crushed limestone aggregate, and Ohio River sand. With the sharp-particle limestone aggregate, up to 1¼ in. in size, this mix had a slump of only 2½ in.

Concrete for Fort Pitt Tunnel lining

Quantities for 1 cu yd, in lb:

Type 1A cement (6¼ sacks)	587.5
Pozzolith	1.5625
River sand	1,100
Crushed limestone (1¼ in. max)	2,020
Water (31½ gal)	263

Typical cylinder strengths:

2 days	2000 psi	14 days	5200 psi
4 days	3400 psi	21 days	5900 psi
7 days	4500 psi	28 days	6300 psi

Placing with pneumatic equipment requires a minimum slump of 4 in. After a series of exhaustive tests, using several concrete admixtures, Master Builder's Pozzolith was selected. It was used in the ratio of ¼ lb per bag of cement and produced concrete with a 5½-in. slump without exceeding the water-cement ratio. Concrete weighed 147 lb per cu ft despite a 4 to 4½-percent average air content. In addition to increasing the workability, Pozzolith retarded the initial set of the concrete to prevent the formation of cold joints during the six-hour pour.

Forms were released and moved ahead when concrete attained a minimum strength of 1,500 psi, about 48 hours after placing. One of the three sections of forms could thus be concreted each day. A fan blowing water from soaker hoses was used to keep the concrete moist during the 7-day curing period.

The Fort Pitt tunnels have a ceiling of wire-reinforced slab 5 in. thick, 14 ft above the roadway. The space above is used for ventilation of the tunnel, the fresh air being forced in and down, then allowed to escape through the portals.

Four traveling 50-ft Blaw-Knox steel forms faced with plywood were used for the ceiling, two under previous 50-ft pours, one under the pour being placed, and one in preparation for concrete. The forward form, when lowered, was moved back toward the

Ceiling tiles are positioned on gummed paper, which holds them in place (left). Wire mesh for ceiling slab is placed over center support (right). In both photos, pipe at top is Pumpcrete line used in placing concrete in ceiling. The soft pipe in photo at left directs air on to grouted tile to speed setting. (Photos, Wire Reinforcement Institute)

portal by a single traveler unit, passing under the other forms.

On top of the plywood form was placed a layer of gummed paper, sticky side up. This was dampened and on it the tiles were placed, face side down. On top of the tile, a dry grout was brushed and subsequently sprinkled. The grout held the tiles firmly in position and properly spaced.

Next the welded-wire-fabric reinforcement was laid over the tiles and held above them by 1-in. cubes of sand cement made on the job. The 2 x 4 x ¼-in. reinforcing weighs 174 lb per hundred sq ft. Wire-fabric sheets of half the tunnel width were placed first, extending from the sides of the tunnel to the center beam. Then the bar reinforcing (previously positioned at ceiling height before the tunnel walls were poured) was bent down to the wire fabric, and fabric and bars were securely tied together.

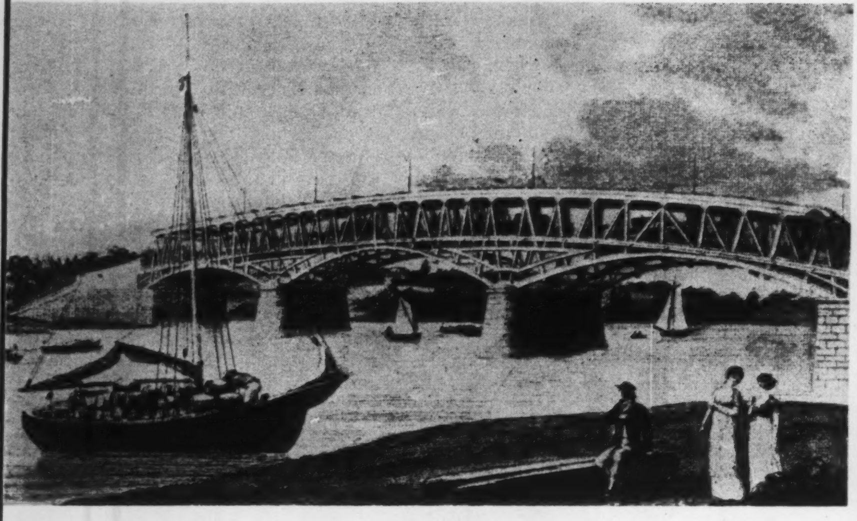
Over the center beam, and spanning the gap between the two sheets of welded-wire reinforcing, a crown-shaped piece of fabric was placed and securely tied. Thus there was a continuous network of reinforcing from one side wall to the other. Double bulb-angles at the center of the ceiling are supported by 7-ft 6-in. stainless-steel hangers, which are bolted to inserts in the tunnel roof.

Concrete similar to that in the tunnel lining, but with smaller coarse aggregate, was used for the 5-in.-thick ceiling slab. It was placed by a Rex Pumpcrete, fed in a manner similar to the pneumatic placer.

The walls are lined with light-colored tile, placed with a mortar back-up on a surface left rough by wires welded to the outside of the tunnel form. Work in the tunnels was practically finished in September. Retaining walls, some building foundations and a parking area remain to be completed.

This use of Pozzolith was the first use of an admixture on a project of the Pennsylvania Department of Highways. It also was the first time an engineering consultant performed all inspection functions on a Pennsylvania highway. Michael Baker, Jr., Inc., of Rochester, Pa., designed the facility and inspected its construction. Joseph G. McCaw is resident engineer and A. E. Cornell, project engineer. For the Pennsylvania Department of Highways George M. Heinitsh is in overall charge.

Merritt, Chapman & Scott constructed the tunnels under an $11 million contract. Work is now more than 90 percent complete to beat a February 19, 1960, completion date. James O. Irwin served as project manager through the major construction, with C. Peter Heaton as project engineer.



First "Permanent Bridge" over the Schuylkill, 1805

Analogies with recent experience noted

NOEL W. WILLIS, M. ASCE
Chief Bridge Engineer

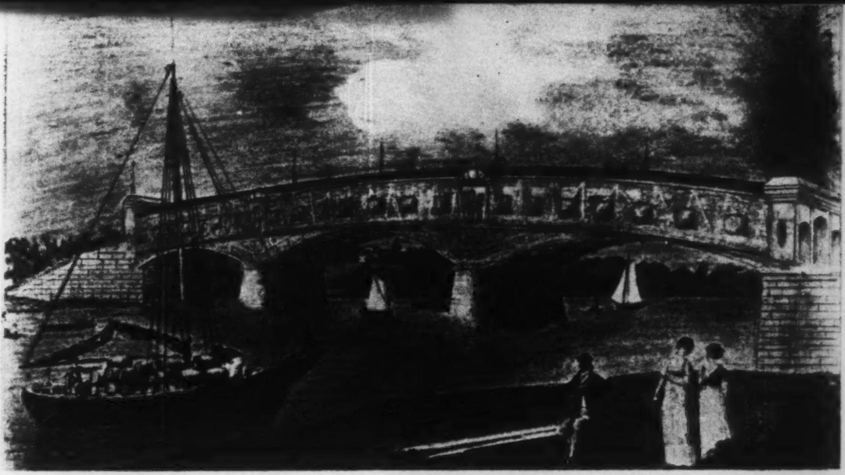
J. LINCOLN MARION
Designing Engineer

Bridge Division, Department of Streets
City of Philadelphia, Pa.

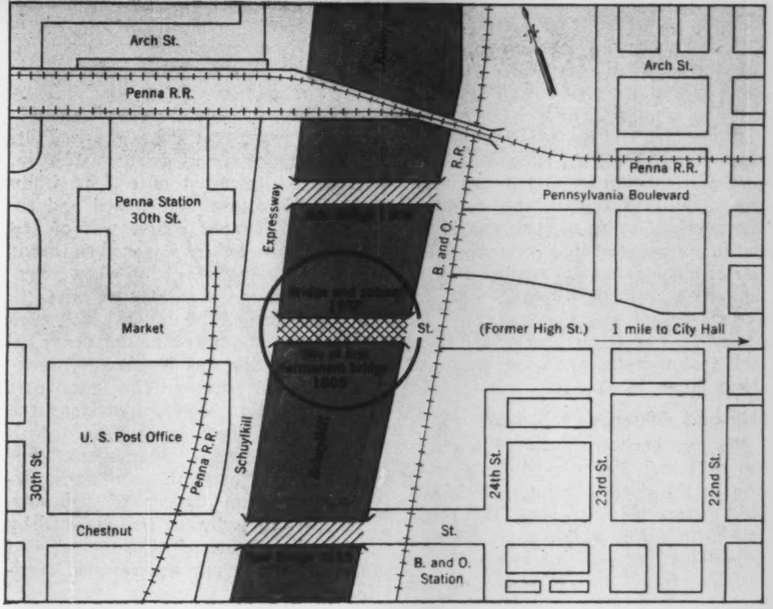
One of the most notable of the early bridges built in the United States was the "Permanent Bridge" constructed on the line of High Street (now Market Street) over the Schuylkill River in Philadelphia, Pa. This structure, begun in 1800 and opened to traffic on January 1, 1805, was an outstanding example of engineering genius.

The circumstances leading up to the details of construction and the attendant hazards make a fascinating study and the modern practitioner cannot fail to view with admiration the skill, daring and foresight of our early American bridge builders. It is interesting to note that the fiscal and engineering problems were not so different from those of today.

The area that later became the site of the "Permanent Bridge" was the location of the first ferry in Philadelphia. This was established in 1683, soon after the arrival of William Penn. Almost a century elapsed before the river was bridged at this point, and the records tell us that the first bridges built there



"Permanent Bridge" across the Schuylkill at Market Street, 1805, is seen in an engraving by Birch (at left) with wooden trusses exposed. Retouched view (at right) is a composite from several sources, showing how bridge appeared after it was covered in 1806.



Site of the "Permanent Bridge" in Philadelphia was at the location of the city's first ferry, established in 1683, soon after the arrival of William Penn.

were of a floating, temporary nature. The community soon began to demand that a bridge be constructed at High Street which could resist the attacks of storm and freshet, as the area beyond the west bank of the Schuylkill was beginning to be developed and a direct link between the two banks would encourage commerce.

In 1787, Thomas Paine, a noted colonial patriot, came forward with what is considered to be the first plan for an iron bridge proposed in this country. It was a single-span arch 400 ft in length and having a 20-ft rise. Paine said that the idea was suggested to him by a spider's web, the small segment of a large circle being preferable to the great segment of a small circle. He constructed a model which was displayed first in Dr. Franklin's house and later taken to Paris for exhibition in the Academie des Sciences.

Paine's bridge model interested the Philadelphia Agricultural Society, and the Assembly was petitioned to examine the model and grant a charter for a permanent bridge at High Street. The Assembly chartered "The Permanent Bridge Company" with a nominal capital of $66,666.66. Its members were John Paine, Samuel Powell, and Robert Morris. The company made a start by inviting designs and appointing a committee to review them, but before real progress could be made, the flood of 1789 destroyed the existing bridges and all available funds were used for their repair. As a result, Paine's progressive plan came to nothing.

In December 1789, the City Council of Philadelphia passed a resolution calling for a permanent bridge to be built, but as the city treasury was "much depleted," they appealed to the state for aid, making several suggestions as to how the money might be raised. How contemporary this problem sounds!

The whole matter lay dormant until the State Legislature passed the Act of March 16, 1798, constituting Richard Peters, John Perot, Godfrey Haga, Matthew McConnel and William Sheoff as organizers of the Schuylkill Permanent Bridge Company, with a capitalization set at $150,000. One of the first problems to be met was the acquisition of the franchise of the ferry operating at the site. This cost the company $40,000, but enabled it to make use of an annual income of $3,500 earned by the ferry during bridge construction.

The company then invited designs, and after reviewing a number of them, finally accepted Timothy Palmer's design for a wooden structure. Palmer was a self-taught architect and his bridge was referred to at the time as representing the birth of "hydraulic architecture." The bridge, shown in an accompanying illustration, consisted of a three-span arch-truss. The center span was 195 ft and the end spans 150 ft each. The rise of the center span was 12 ft and that of the end spans, 10 ft. The geometric form of the arch was a catenary. It supported a deck 42 ft wide.

Abutments and wing walls were perpendicular, without buttresses, and were supported by interior offsets. The abutments were 18 ft thick, the eastern one being founded on rock and the western one on a platform supported by piling.

The piers were 71 ft 6 in. long at the bottom, and battered to a length of 61 ft at the top. They were 30 ft thick at the base and 19 ft thick at the top. The east pier was 40 ft high and the west one 56 ft high. Both were founded on rock. The cost of construction was about $300,000, a great part of the expenditure being consumed on cofferdams, foundations, and other subaqueous work.

Work was begun on October 18, 1800, and continued apace on the abutments and easterly pier. The westerly pier was something else again and was attended by "great difficulties, a constant hazard, and unavoidable expense." The cofferdam for this pier contained some 800,000 fbm of lumber and took seven months to construct and dewater. The depth of water to rock was 41 ft, and it was believed that no comparable pier of regular masonry existed at that time. It is further recorded that the western pier was "commenced on Christmas Day 1802," and erected from rock to low-water mark, at height of about 30 ft, in 41 days.

Skill and diligence of builders

Modern engineers must marvel at the skill and diligence of those men, who in the dead of winter 1802-1803 built a stone pier 71 ft long, 30 ft thick, and 30 ft high in such a short space of time. This feat received attention and acclaim from contemporary bridge builders all over the world.

It is easy to understand the tone of elation that characterized the report of the building committee to its company, rendered on February 23, 1803. It stated that the western pier was "out of the water," and requested final approval of the timber superstructure as designed by Timothy Palmer.

This report, carried in full in *Poulson's American Daily Advertiser* of February 24, 1803, sets forth the plan for the year to follow. The committee felt that the timber superstructure was the best for the purpose because it could be completed most quickly and, if covered, would be durable. It was compared to the Schauffhausen Bridge over the Rhine River, which was built in 1758 of alpine fir (said to be inferior to our white pine) and lasted 38 years until destroyed by French troops in 1796. The Building Committee also reported that an additional $70,000 was needed to complete the work and that the treasury was exhausted "much more by accidents and misfortunes, which could not be prevented, than in the actual work of erection." Subscriptions were opened and the necessary funds were soon obtained.

The frame or superstructure was a masterly piece of workmanship, combining in its principles king posts and braces (trusses) with those of the arch. Half of each part, with the brace between the parts, formed the voussoir of an arch, and lines through the middle of each post described the radii of the joints. Most major bridges of the day followed the same plan, a favorite approach being to support the truss partially by diagonal knee braces extending outward and upward from the pier. It is interesting to note that truss analysis was not understood until nearly 1850, although the theory of arch analysis was announced about 1826. Thus neither of these methods of analysis were known when this bridge was built.

Flooring of the roadway was 5½ in. thick and consisted of a 3-in. white pine undercourse well spiked and secured. The upper course was of sap pitched pine, lightly attached so that it could be removed easily when worn. The undercourse wore two or three times as long as the upper, which wore down and splintered before decaying.

The exterior was handsomely ornamented and painted. The lower part was treated to appear like stone, the paint while fresh being dashed with sand and stone dust. A number of conductors were placed to secure the superstructure from danger of lightning. The eastern pediment was crowned by a wooden statue of "Commerce" and the western by one representing "Agriculture." The company ornamented the structure further by erecting a marble obelisk on the western end, which bore a sundial and inscriptions giving the main facts on the history of the bridge.

At the center of the bridge was the toll house, where rates were as follows:

Rates of toll over permanent bridge

For every:	Cents
Foot passenger	1
Horse or mule without rider or harness	1
Same with rider	2
Herd of horned cattle (not over 20)	1
Living sheep, swine or calf	½
Four-wheel carriage drawn by 4 horses	20
Same drawn by 2 horses	12
Same drawn by 1 horse	10
Two wheels or sleigh drawn by 2 horses	10
Two wheels or sleigh drawn by 1 horse	6

Philadelphians were very proud of their bridge and the company prospered. In 1840, when the City of Philadelphia acquired title to the bridge for a sum recorded as approximately $100,000, all tolls were abolished. Nine years later it was reconstructed to accommodate the tracks of the Philadelphia and Columbia Railroad (now the Pennsylvania Railroad Company). These were placed on the north side, and the south side was occupied by the West Philadelphia City Passenger Railway. The bridge remained in constant use until November 20, 1875, when it was totally destroyed by a fire resulting from a gas-main explosion.

Later experience similar

The reader may be interested to know that later experience with foundation construction in the center of the Schuylkill River and along its western bank parallels that of the builders of 1802 to a remarkable extent. The original Chestnut Street Bridge, built in 1861-1865, was a two-span cast-iron arch whose western abutment slipped badly in the 1870's, as a result of the horizontal thrust of the arches, and had to be underpinned at great expense. When the Chestnut Street Bridge was reconstructed in 1957, the cofferdam for the river pier cost $125,000, which gives some idea of the complexity and hazardous nature of the work.

The recently completed bridge carrying Pennsylvania Boulevard over the Schuylkill River presented similar difficulties. Its builder was faced with the collapse of the cofferdam for the western pier during the early stages of construction.

A comparison of construction costs may be interesting. The Permanent Bridge cost $300,000; the Chestnut Street Bridge, built in the 1860's, cost $500,000; the new Chestnut Street Bridge, $1,300,000; and the Pennsylvania Boulevard Bridge, $1,325,000.

Time and subsequent encounters with the same terrain and forces of nature must necessarily enhance our respect for the determination and engineering genius of the designers and builders of the "Permanent Bridge" as well as for their contribution to the tradition, art, and science of American bridge building.

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Twenty miles below Lake Tana, the Blue Nile drops approximately 150 ft in spectacular Tissisat Falls.

MULTIPURPOSE INVESTIGATION of the *Blue Nile*

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Assistant Commissioner

Bureau of Reclamation

Washington, D.C.

There are numerous possibilities for future construction of a series of major dams, power plants, irrigation canals and pumping plants in the basin of the Blue Nile in Ethiopia. Hard at work developing basic hydrologic and mapping data on the basin are engineers from the U.S. Bureau of Reclamation and the Coast and Geodetic Survey, working with engineers of the Imperial Ethiopian Government. By 1964, the Bureau is scheduled to complete an engineering and economic evaluation of the water resources of the Blue Nile Basin, sufficiently detailed to identify the best dam sites, irrigation and power projects, and related features.

The Empire of Ethiopia is in the northeast part of Africa adjacent to the Red Sea (Fig. 1). The country is bordered on the north and west by the Sudan, on the south by Kenya, and on the east by Somalia, British Somaliland and French Somaliland. Its area, about the size of Texas and New Mexico combined, totals about 398,000 sq miles. In geography, Ethiopia is not unlike much of the western United States. The central part is a high plateau known as the Highland Plateau of Ethiopia. It is the source of a number of international rivers and intracountry streams, fed not by melting

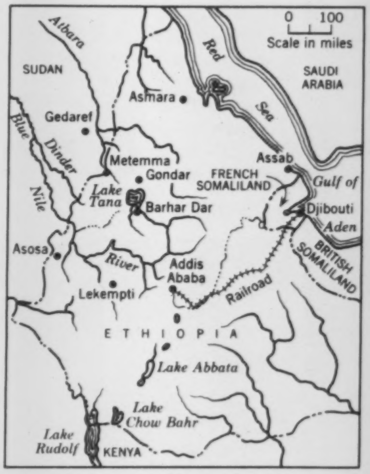

Atbara
SUDAN
Red
Sea
0 100
Scale in miles
SAUDI ARABIA
Asmara
Gedaref
Blue
Dinder
Nile
Metemma
Gondar
Lake Tana
Barhar Dar
Assab
FRENCH SOMALILAND
Gulf of
Djibouti
Aden
BRITISH SOMALILAND
Asosa
River
Addis Ababa
Lekempti
Railroad
E T H I O P I A
Lake Abbata
Lake Chow Bahr
Lake Rudolf
KENYA

FIG. 1. Blue Nile has its source in Lake Tana, some 40 by 60 miles in area.

Left to right: Dr. Haile Giorgis Workneh, A.M. ASCE, Director, Ethiopia's Department of Surveys and Water Resources; Alfred R. Golze, F. ASCE, Assistant Commissioner, U. S. Bureau of Reclamation; His Excellency Dejazmatch Mangasha Seyoum, Ethiopia's Minister of Public Works and communications; Admiral H. Arnold Karo, Director, U. S. Coast and Geodetic Survey; and Ato Saleh Hinot, Ethiopia's Director General of Public Works.

snow banks but by monsoon rainy seasons. These rivers have cut deep gorges and innumerable lesser valleys throughout the plateau country.

The Highland Plateau averages 8,000 ft above sea level. In the east it drops off sharply to sea level. Running north and south through the eastern part of the plateau is "the Great Rift," which extends from Lake Victoria in Uganda across Ethiopia, up the Red Sea and the Gulf of Aqaba to the Dead Sea in Jordan. In Ethiopia it is as much as 60 miles wide and from 2,000 to 3,000 ft deep.

The growing population of the country currently approximates 20 million. Addis Ababa, the capital city, is located in the central part of the Ethiopian plateau at an elevation of 8,000 ft. Although the rainfall is largely seasonal, it provides for enough crops to maintain the present population and to support the livestock that is owned in large numbers by Ethiopian farmers. Coffee is the principal crop grown for export. Hides, skins, cereals, oils, and seeds are also exported. To meet its growing population needs, Ethiopia's greatest economic asset is probably the undeveloped water resources of its rivers.

Of the many rivers in Ethiopia, the greatest of interest to the Imperial Ethiopian Government today is the Abbai or Blue Nile. This river has its source at Lake Tana, a fresh-water lake about 40 by 60 miles in area located in north-central Ethiopia. From this lake the Blue Nile flows in a large loop first southeast, then south and then west. Twenty miles from Lake Tana it drops approximately 150 ft in the spectacular Tissisat Falls. Less than 50 miles from Lake Tana it begins to cut through the plateau a deep gorge, which in places is 4,000 ft deep. The river emerges from the plateau close to the western border of Ethiopia, where it turns northwest and crosses the boundary into the Sudan. At Khartoum, the capital of the Sudan, the Blue Nile joins the White Nile to form the main stem of the River Nile.

The distance from Lake Tana to the Sudan border is about 535 miles. Lake Tana is about 6,040 ft above sea level; and the estimated river elevation at the Sudan border is 1,970. Thus the river drops 4,070 ft in cutting its way across the Highland Plateau. This drop represents the potential power head of the main-stem system, none of which is now developed. In May 1959, Emperor Haile Selassie laid the cornerstone for what will be the first power plant on the Blue Nile, at Tissisat Falls.

The international importance of the Blue Nile is evidenced by the fact that gaging stations in the Sudan show that it contributes at least 67 percent of the waters of the Nile River below Khartoum.

A number of studies have been made of the Blue Nile, going back as far as 1902. At first these studies were made for the purpose of regulating the river for downstream use. The more recent studies have been made to determine the resources of the river for use within Ethiopia. The most recent studies include the Lake Tana Report of the J. G. White Corporation in 1935 and a preliminary reconnaissance made by the Bureau of Reclamation in 1952 under the direction of Tom A. Clark. The Bureau of Reclamation's preliminary study concluded that sufficient storage could be provided along the Blue Nile and its tributaries to permit full utilization of the river for power and irrigation in Ethiopia without jeopardizing developments in the lower valley. This preliminary reconnaissance pointed out, however, that further intensive studies within Ethiopia must be made as a basis for determining actual construction requirements for the dams, power plants and canal systems needed to realize the river's potential within Ethiopia.

Through the International Cooperation Administration the U.S. Government has a program in operation in Ethiopia for technical assistance. In 1956, following the recommendations of the Clark Report, an agreement was concluded between the Imperial Ethiopian Government and ICA for a study of the water resources of the Blue Nile basin. At the request of the ICA, the Bureau of Reclamation of the Department of the Interior agreed to provide the technical assistance in connection with this program. The Bureau's technical assistance program is divided into three parts:

1. Investigations to determine the resources of the area so that the data thus acquired can be used for the planning of specific construction projects.
2. Recommendations for the establishment of a Department of Surveys and Water Resources within the Imperial Ethiopian Government.
3. Training of Ethiopian engineers and technicians in water resources development so that similar work can subsequently be carried on in the other river basins of the country.

The Bureau's investigation program now under way in Ethiopia falls somewhere between what would be classed in the United States as a reconnaissance program and a feasibility-type program; that is, the investigation will definitely identify potentially important sites for power plants on the main stem of the Blue Nile and its principal tributaries. It will locate areas suitable for the growing of crops under irrigation, as well as areas unsuited to modern irrigation. The report will evaluate the economics of the various dam sites and irrigated areas with regard to their future worth in the internal economy of Ethiopia. For example, power will be evaluated for industrial use, expansion of the mining industry, agricultural purposes including pumping of irrigation waters, municipal and domestic use in villages and towns, electrification of railways, and production of fertilizers, all essential factors in the continued growth of the country.

Irrigation will be evaluated for crops that vary according to elevation, and with reference to the domestic needs

Typical Ethiopian scene shows valley land dry farmed. Valley floor is composed of lava flows from crater near center.

of the country and to export possibilities to build up foreign trade and exchange. The target date for completion of the Bureau's report is June 30, 1964.

Limited hydrologic records on the Blue Nile indicate that about 7 percent of its annual flow comes from Lake Tana, out of its average flow of approximately 40 million acre-ft a year where it crosses the border into the Sudan. The great increase in flow comes from its tributaries between Lake Tana and the border, of which there are six main ones—the Bascillo, Giamma, Guder, Ciamoga, Didessa, and Dabus.

The monsoon rainy season brings seasonal variations in river flows. In the lowlands to the west of Ethiopia, floods are an annual occurrence. To develop data on the behavior of the river system, the Bureau is working with the Department of Surveys and Water Resources of the Imperial Ethiopian Government to install 21 sediment recording gages and 17 staff gages on the river system. Since sedimentation promises to be a serious problem at places along the Blue Nile, sediment sampling is being provided for at all gaging stations.

Basic to the Bureau of Reclamation investigation and all construction work on the Blue Nile is accurate mapping of the river basin. This is now under way under an agreement between the U.S. Coast and Geodetic Survey and ICA with the Imperial Ethiopian Government. Working east from the base datum on the arc of triangulation that runs through central Africa, and from established elevations in the Sudan, engineers of the U.S. Coast and Geodetic Survey and the Imperial Ethiopian Government are bringing the leveling and triangulation into Ethiopia.

Leveling operations involve surveying a distance of 1,100 miles from Gedaref in the Sudan to Gondar in Ethiopia, south to Addis Ababa, west to Lekempti, and north to Metemma, where the original line from the Sudan is intersected. All elevations are measured twice; the entire distance of 1,100 miles is being covered on foot, a total of 2,200 miles.

The triangulation work, which is done at night, includes the establishment of three first-order base lines for future surveys of lower order. In addition, the entire Blue Nile River Basin has been photographed from the air. A total of 11,992 photographs were taken at 32,000 ft above sea level, each photograph covering 50 sq miles. From these photographs mosaic maps will be prepared, followed by the detailed maps required by the Bureau of Reclamation for determining potential irrigated areas and dam sites on the Blue Nile and its tributaries. All mapping work is carried out in cooperation with the Imperial Ethiopian Mapping and Geography Institute.

The activities of the Bureau of Reclamation and the U.S. Coast and Geodetic Survey include the training of Ethiopian personnel. As rapidly as local engineers and technicians can be made available they are assigned to direct or staff field parties and to perform other duties. They are given responsible assignments in connection with survey parties, gaging work, geology, land classification, and such other work as will qualify them for positions in Ethiopia's Department of Surveys and Water Resources. It is expected that, with personnel trained in this way, the Imperial Ethiopian Government will be in a position, even before 1964, to investigate and evaluate the resources of the other river basins in Ethiopia.

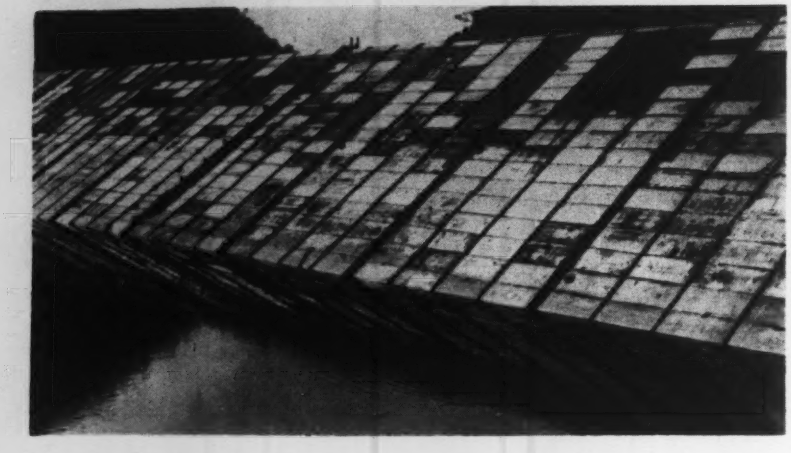
The Bureau of Reclamation has completed and furnished to ICA for transmittal to the Imperial Ethiopian Government, an Organization Plan for a Department of Surveys and Water Resources in the Ministry of Public Works and Communications. While the organization is planned primarily for the present investigation program, provision is made in it for a construction division which, it is expected, will direct a major construction program on the Blue Nile and other river basins when work is ready to proceed.

The Bureau of Reclamation currently has a staff of 8 engineers and 4 other employees on the Blue Nile survey. Plans call for an expansion of this staff to 19 engineers and 6 other employees by June 1960.

In charge of the Bureau's work is Project Engineer Donald P. Barnes, F. ASCE, responsible to the Commissioner of Reclamation for the technical performance. In Ethiopia he is associated with J. H. Rives, chief of the Division of Water Resources, USOM, and Mr. Herman Kleine, Mission Director for ICA. For the Bureau of Reclamation, general responsibility for the program rests with the Commissioner of Reclamation, Floyd E. Dominy. The writer is the Assistant Commissioner in charge of foreign activities, and Leon W. Damours, M.ASCE, is Chief of the Foreign Activities Division of the Bureau of Reclamation. Grant Bloodgood, F. ASCE, is Assistant Commissioner and Chief Engineer at Denver, Colo., responsible for the technical performance of the Bureau of Reclamation's team in Ethiopia. Dr. Haile Giorgis Workneh, A.M.ASCE, and a graduate of the Massachusetts Institute of Technology, is Director of Ethiopia's Department of Surveys and Water Resources.

Only one highway bridge crosses the 500-mile length of the Blue Nile within Ethiopia.

Upstream face of Rio Lagartijo Dam after one season of use.



A steel-faced rockfill dam

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Speed of construction and structural integrity were the chief advantages gained by the use of a steel-plate facing on a rockfill dam built in Venezuela in 1958. At present, steel-plate facing is seldom considered for use on earth and rockfill dams, although a number of such dams have been built in the past and have seen many years of satisfactory service. The principal reasons for not considering steel facing for dams have been concern about possible corrosion of the steel, and cost. However, the advantages offered by steel-plate impervious membranes for dams are such as to justify the consideration of this type of construction under some site conditions. Experience with structures in the Western United States gives weight to this statement.

Rio Lagartijo Low Dam

In recent years the demand for domestic water in Caracas, Venezuela, has grown considerably faster than anticipated, and a severe shortage developed in 1957. During 1957 and 1958, water had to be severely rationed and a supplemental supply had to be brought into the city in tank trucks from sources outside the system. The cost of the supplemental water and the inconveniences caused by the shortage led the Instituto Nacional de Obras Sanitarias (INOS) to accelerate the rate of construction of new storage facilities.

Previously planned for construction in the early 1960's was a large reservoir to be formed by an earthfill dam 164 ft high on the Rio Lagartijo, about 40 miles southeast of Caracas. The size of this dam and the incomplete state of the design studies made it impracticable to attempt its completion in time to alleviate the water shortage anticipated during the 1959 dry season. Consequently it was decided to proceed immediately with the construction of a low dam on the Rio Largartijo some 3,300 ft upstream from the site chosen for the main dam. The low dam was expected to have a useful life of only two or three years. Because of the temporary nature of this structure, it was desirable to construct it as economically as possible, consistent with complete safety. But the designers had to keep in mind the fact that although the dam was planned to have a life of only a few years, it might be used for a much longer period.

In April 1958, the Venezuelan firm of OTEHA, C.A., was commissioned to prepare plans and supervise construction of the "low dam," to have a height of 79 ft. Construction started in May, filling of the reservoir started in September, and the dam was completed in December—all in 1958. The water stored during the rainy season of 1958 provided a sufficient additional supply for Caracas to prevent serious shortage in 1959.

The brief time available for design and construction, and the imminence of the annual rainy season, prohibited consideration of a conventional earthfill dam.

Because of the very limited time available and the fact that no borrow-pit explorations or laboratory studies had been made, the engineers concentrated immediately on a rockfill design. Alternate plans were prepared for rockfill dams having upstream impervious membranes of reinforced concrete and plate steel. The contractor made cost estimates for each and concluded that the plate steel was the cheaper.

A section through the dam, as constructed, is shown in Fig. 1. The foundation consists of 25 to 30 ft of river alluvium. The upper half of this foundation layer is made up of a dense stratum of river gravel. Underlying the gravel is a layer of sandy silt. Time was not available to remove the alluvium down to bedrock. Time was not even available for a careful field and laboratory exploration of the characteristics of the silt layer. A few small-diameter Shelby-tube samples were obtained from various points in the silt layer, and some classification tests and unconfined compression tests were performed.

Stability calculations, based on the results of the unconfined compression tests, indicated that the embankment could be constructed with the slopes and height indicated without danger of foundation shear failure. It was expected that considerable foundation settlement would take place during and after construction. However, since the dam was sufficiently flexible to withstand large differential settlements without rupture, the designers were not particularly concerned about this.

A cutoff wall or seepage barrier, to prevent excessive percolation through the foundation, was provided by con-

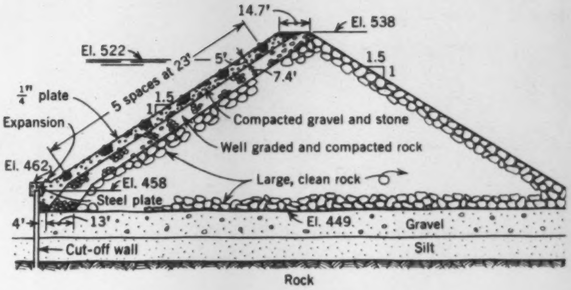
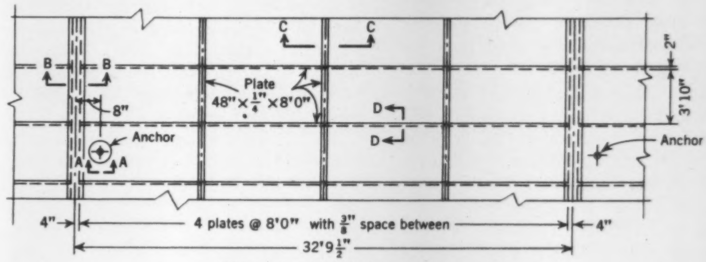
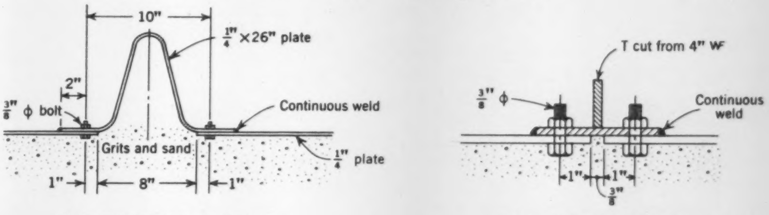

14.7'
El. 538
El. 522
5'
1.5
1
7.4'
5 spaces at 23'
$\frac{1}{4}$" plate
Expansion
1.5
1
Compacted gravel and stone
Well graded and compacted rock
El. 462
El. 458
Large, clean rock
Steel plate
4'
13'
El. 449
Gravel
Cut-off wall
Silt
Rock

FIG. 1. Cross section through Rio Lagartijo Dam, shows types of fill and steel-plate facing on upstream face.

FIG. 2. Details illustrate connections for steel-plate facing.


C
C
B
B
Plate
48"×$\frac{1}{4}$"×8'0"
8"
Anchor
A
A
D
D
2"
3'10"
Anchor
4"
4 plates @ 8'0" with $\frac{3}{8}$" space between
4"
32'9$\frac{1}{2}$"

STEEL-PLATE FACING—PORTION OF PLAN


10"
$\frac{1}{4}$"×26" plate
2"
$\frac{3}{8}$" ϕ bolt
Continuous weld
Grits and sand
$\frac{1}{4}$" plate
1"
8"
1"
T cut from 4" WF
$\frac{3}{8}$" ϕ
Continuous weld
1"
1"
$\frac{3}{8}$"

B–B EXPANSION JOINT

C–C JOINT ALONG SLOPE

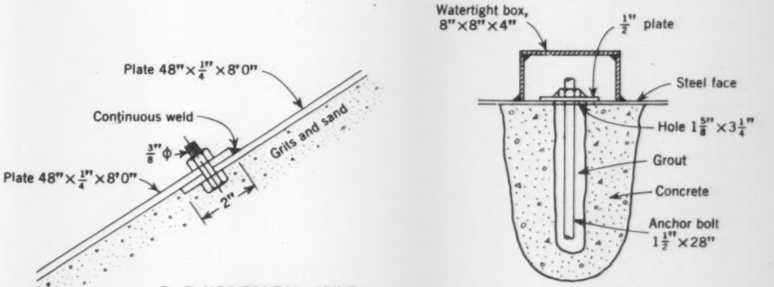


Plate 48"×$\frac{1}{4}$"×8'0"
Continuous weld
$\frac{3}{8}$" ϕ
Grits and sand
Plate 48"×$\frac{1}{4}$"×8'0"
2"
Watertight box,
8"×8"×4"
$\frac{1}{2}$" plate
Steel face
Hole 1$\frac{5}{8}$"×3$\frac{1}{4}$"
Grout
Concrete
Anchor bolt
1$\frac{1}{2}$"×28"

D–D HORIZONTAL JOINT

A–A ANCHOR

structing a 20-in.-wide concrete wall at the upstream toe. This cutoff wall was constructed according to the patented ICOS process. The trench was excavated to bedrock by drilling holes and excavating between them with a clamshell bucket. During the excavation the trench was kept filled with a bentonite slurry, which prevented the walls from caving and eliminated the need for sheathing. After the trench was excavated to bedrock, tremie methods were used to place the concrete, which displaced the bentonite slurry mixture. Vertical pipes were placed in the trench for subsequent grouting of the bottom of the trench, and to permit drilling into the bedrock for further foundation grouting.

Rock used for the embankment was a hard, sound, bulky limestone, with a maximum size of 10 tons. Only clean, large, hard rock was placed in the embankment, which was constructed in layers ranging from 10 to 13 ft. It was sluiced continuously with nozzles of the largest size that could be handled by hand. The sluicing was used to consolidate the embankment and to wash the fines into the interstices of the rock embankment. The 7-ft-thick layer of well-graded fine rock on the upstream slope was obtained as quarry-run fines. Gravel for the 5-ft-thick layer came from deposits in the stream bed. Both of these sloping layers were placed after the main embankment was completed. They formed a cushion to prevent high concentration of stress between the upstream steel face and the large individual rocks in the embankment.

Details of the steel-plate connections are shown in Fig. 2. To provide flexibility in the steel membrane, which would allow it to deform without rupturing or developing extensive tensile stresses, transverse expansion joints were provided vertically up the face on 33-ft centers. An expansion joint consists of a simple fold in a steel plate, which permits considerable movement of the steel at the joint. All joints were continuously welded.

The steel facing is anchored into the underlying gravel layer by bolts embedded in concrete, also shown in Fig. 2. These are spaced 33 ft apart horizontally and 23 ft parallel to the slope.

At the upstream toe of the dam, the steel plate is connected to the top of the concrete cutoff wall, using a double-expansion joint. At the abutments the steel plate is sealed into a 20-in.-wide concrete wall extending 3 to 5 ft into the rock.

The steel plates, connections and expansion joints were fabricated in Caracas. Large sections of the upstream face were connected with field bolts before completion of the continuous fillet welds united all the plates and connections into a watertight unit. Odd-shaped plates to fit the natural contours of the abutment were cut and welded in the field. The steel plates were placed directly on top of the gravel layer, which had been carefully compacted to a plane sloping surface on grade. In the middle of the day the plates became so hot that they were difficult to handle. Work on them was done only during the morning and evening hours, between 5 and 10 a.m. and 4 and 10 p.m. Connecting the plates when they were hot and expanded was thus avoided.

This construction procedure differs from that on several dams in the United States, where steel plate was laid on gravel. During construction of the United States dams, the steel plates were placed on carefully leveled lightweight steel angles. After the plates were fastened to the angles, the space between the plates and the embankment was backfilled with gravel. The angle frames were left embedded in the backfill, the legs acting as anchors for the plates. This method resulted in a slightly smoother and more attractive face than was obtained by placing the

Steel plate terminates at crest. Note the expansion joint and the ridge made by the 4-in. WF split into a T.

From the crest, the steel-plate facing looks like this. Cathodic protection is being installed.

plates directly on gravel. About eight weeks were required for completing the construction of the steel face for the Rio Lagartijo Dam.

A most interesting feature of this dam is the provision of cathodic protection for the steel plate. This is probably the first installation on which such protection has been used. The protective system was developed by the engineers of INOS as a result of experimentation with cathodic protection of steel members in the Mariposa water treatment plant for Caracas. Details are shown in Fig. 3.

The cathodic protection system is operated from 110-v alternating current that is fed into a rectifier. The rectifier is grounded directly on the steel plate with a copper cable near the crest of the dam. The positive lead is through shunts to used steel rails that run vertically down the slope of the dam. The steel rails are separated from the steel face by 2-in. rubber insulators. The shunts provide each steel rail with a potential of about 1 v.

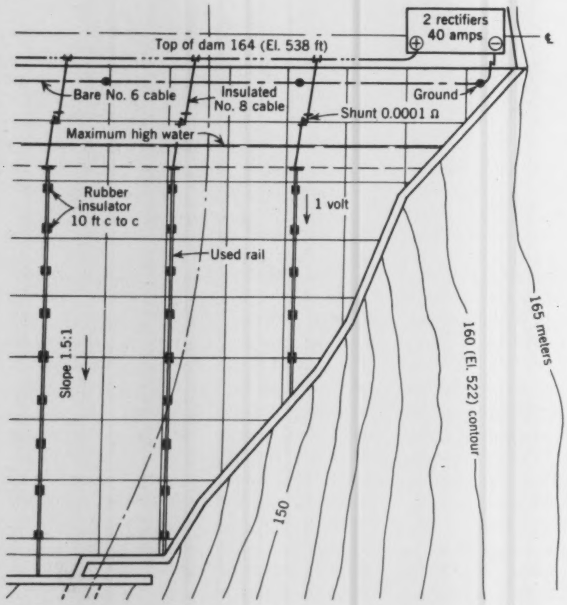


FIG. 3. Cathodic-protection features are indicated on end of dam, seen in plan. Used rails act as anodes; the steel-plate facing itself serves as cathode.

Using this system, the upstream steel face of the dam becomes the cathode and the expendable steel rails the anode. Computations indicate that the steel rails will corrode at a rate of about 100 kg per year.

Experiments made by the corrosion engineers of INOS indicate that more current will flow in the system during the first few months after the cathodic protection system is installed than later. Carbonates will deposit on the steel, providing a thin protective covering and a deterrent to the flow of electricity. Consequently the power necessary for cathodic protection will diminish with time.

Performance record

The reservoir was almost completely filled by the end of the 1958 rainy season. The level receded as water was drawn off for the Caracas water supply during the 1959 dry season. The reservoir is again filling during the 1959 wet season.

The dam is in excellent shape. No measurements of embankment settlement have been taken, but settlement is not so great as to be noticeable on the crest of the upstream face. Even though the steel-plate facing was not painted, and the cathodic protection was not installed until July 1959, rusting of the steel plates during the first year was negligible. Considerable leakage appeared downstream from the dam. Through the use of dyes and observation by a diver, it was established conclusively that the leakage was through the upper part of the foundation cutoff wall. The steel face was intact and watertight.

The Rio Lagartijo Low Dam, described above, was designed and the construction supervised by the Caracas engineering firm of OTEHA, C.A. Work was carried out under the direction of Dr. Diego Ferrer-Fernandez, M. ASCE. Construction was done by the firm of Technica Constructora C.A. of Caracas.

Steel plate on U.S. dams

While there have been very few dams constructed in the United States with steel-plate upstream faces, experience with these dams has generally been good. Corrosion of the steel plate has not resulted in severe maintenance problems.

Rockfill Skagway Dam was built about 1900 in the Rocky Mountains near Victor, Colo. It has a height of 75 ft. The steel plate on the upstream face has a thickness of 1/2 in. at the bottom, 3/8 in. at mid-height, and 1/2 in. at the top. The facing was "riveted and calked in the same thorough manner as in boiler practice."

In the last 30 years the steel face has been given two complete treatments of cleaning, chipping, buffing and painting. The last of these was in 1940. Concerning its present condition, the owner states:

"Through the years the steel face has become pitted, but not to the extent to become alarming. . . . We are not able to examine the fill side of the steel, but have examined the portion extending above the fill on the cap of the dam at ground level and find that it has suffered less damage than the water side. . . . The steel face has not received the maintenance it should have but . . . it has stood the years very well."

When it is considered that this steel facing is about 60 years old and that the quality of the steel is probably much less uniform and desirable than that in use today, this is a very good recommendation for the durability of steel plate on the upstream face of a dam.

Gravel-filled El Vado Dam, with ¼-in. steel plate on the upstream face, was constructed in New Mexico in 1934. The dam has a maximum height of 175 ft and a 1.5 to 1 upstream slope. The maintenance forces report that "the steel plate is in excellent condition at the present time and with minor inexpensive repair work from time to time should have a life as long as the dam."

Two other earth or gravel dams 80 to 100 ft in height, constructed in the Rocky Mountains in Colorado in the early 1930's, have ¼-in. steel plate on the upstream face. Detailed information on the maintenance of these dams is lacking but the writer has inspected their steel faces several times in the past 10 years. They appear to be in excellent shape and there are no signs of undue corrosion. From experience with these structures, it can be concluded that corrosion has not been a serious problem on steel-faced dams and that, with reasonable maintenance, the steel face can be considered permanent.

Advantages of steel-plate facing

Flexibility, watertightness and best distribution of reservoir water pressure are advantages attained by steel-plate facing. The steel plate itself is very flexible and can withstand a great deal of embankment movement without danger of rupture. Through the use of simple and economical expansion joints, of the type used at Rio Lagartijo Dam, the steel-plate facing can be made sufficiently flexible to withstand whatever settlements an embankment or foundation is likely to undergo.

For all practical purposes, steel-plate facing is completely impermeable. When supported on a uniform layer of compacted gravel, the steel plate is not required to resist bending or tensile stresses and acts only as a water barrier or impervious membrane. Used in this fashion, a thin steel plate is capable of acting as an impervious membrane for a reservoir of any depth.

The further upstream the water pressure is resisted by the dam, the greater the stability of an earth or rockfill dam when the reservoir is full. The steel upstream membrane resists pressure on the plane of the upstream face, which is the optimum condition. Assuming proper drainage, there is no problem of decreased slope stability caused by internal pore pressures, following "rapid drawdown" or in the "steady-state seepage condition." The dam is not subject to the weakening influence of water seeping through the embankment. Consequently earth dams with steel faces are very different structures from ordinary earth dams and can be constructed on steeper slopes.

Steel-plate facing provides complete protection against the erosive forces of waves.

Drawbacks

There are three principal disadvantages in the use of steel plate: (1) the cost, (2) the possibility of damage due to corrosion, and (3) the necessity for drawing down the reservoir level occasionally for inspection and possible repairs. The cost is a major disadvantage, particularly for low dams. At the present time in the United States, it should be possible to put a ¼-in. steel plate in place on the upstream face of a dam for $20 to $25 per sq yd. For a low dam the cost of the steel plate would be an appreciable part of the total cost of the structure. For high dams, which are thick at the base, the cost of the steel plate in relation to the cost of the embankment becomes much less. Consequently, the higher the dam, the better the competitive position of a steel facing.

Fear of corrosion has probably been the main deterrent to the use of steel plate on dams. However, experience has shown, as discussed above, that the few steel-faced dams in the United States have been remarkably resistant to corrosion. Advances in corrosion engineering should make it possible to reduce this danger to zero, although many engineers would consider this unnecessary.

It would probably be wise to use a steel face on the upstream slope of a dam only where it would be possible, without excessive cost and inconvenience, to completely drain the reservoir at intervals to inspect the condition of the face and repair the steel plate if necessary. On the other hand, any earth or rockfill dam may develop trouble of sufficient magnitude to make it extremely desirable to drain the reservoir completely. Also, some repair work can be done on the steel face by divers, which is an advantage not enjoyed by earth dams with internal clay cores that may develop cracks or leaks. Therefore the necessity for drawing down the water level constitutes only a slight disadvantage for a steel-plate face.

In summary, the writer believes that the data available indicate that steel-plate facing should receive more consideration from dam designers than it has in the past. Some site conditions that make it especially desirable to consider a steel upstream face will now be discussed.

Conditions favoring steel facing

No impervious soil. Where impervious soil for an earth core is not available within an economical haul distance, an upstream diaphragm of steel plate may serve the purpose very well.

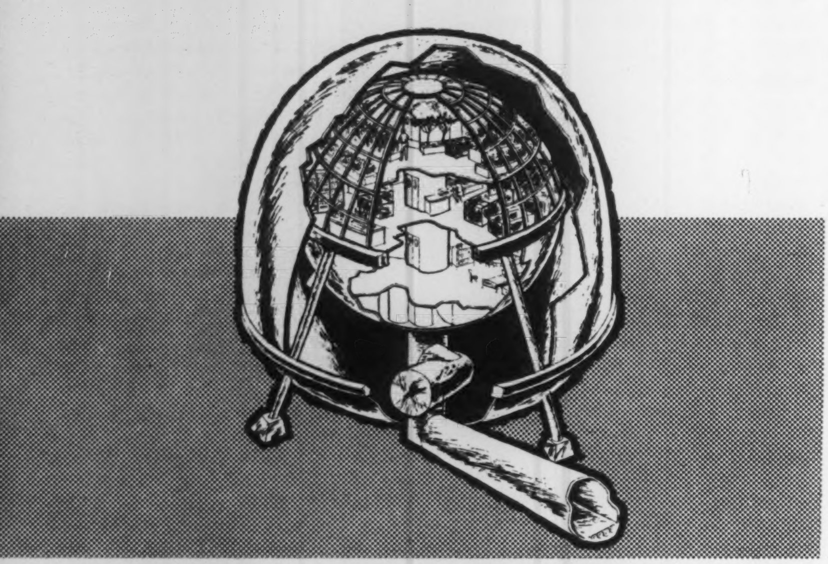
Possibility of embankment cracking. Recently some earth dams have cracked as a result of differential settlement. This is particularly alarming since there are no reliable criteria by which the possibility of cracking can be analyzed and steps taken to avoid it. The problem is becoming increasingly severe as the height of dams becomes greater and greater. In some dams, intricate and expensive drains and graded filters have been provided to minimize the danger of seepage through possible embankment cracks. The use of an impervious membrane of steel plate would eliminate all danger of failure caused by excessive seepage through embankment cracks.

Economy with hard rock. Where the abutments and foundation for a dam consist of strong rock, and where an ample supply of strong granular embankment material is available, the steel-plate upstream membrane may result in the most economical design, even if clay is available for an impervious core. If a clay core is used, the embankment will probably be constructed with a slope of 1 on 2½ upstream and perhaps 1 on 2 downstream. If the embankment is constructed using only the strong granular material available and an upstream steel face, there will be no danger of embankment sliding, with water held completely outside the structure. Consequently the embankment slopes can be made as steep as practicable from the construction standpoint, which may be 1 on 1.2 or steeper. Obviously the steel-face design would have a much smaller embankment volume and might be considerably cheaper.

Severe wave action. Where severe wave action is expected in the reservoir, and rock for a riprap blanket involves an exceptionally long haul, the cost of any type of suitable wave protection may approximate that of steel plate.

Editors Note: After visiting the Rio Lagartijo Dam in Venezuela this summer, Mr. Sherard volunteered to prepare this article on the interesting, but little known, steel-faced type of dam construction.

Structures for the MOON



The first building on the moon may well look like the structure inside of the lunar housing simulator here pictured. This double-walled structure will be erected next year on the grounds of the 21st Century Exhibition in Seattle, Wash. It is designed to be completely self-sustaining and to accommodate five men.

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At present, the idea of building and operating a base on the moon appears fantastic to most engineers. But considering the rapid and forced advancement in long-range missile design, coupled with the marked interest of the governments of the scientifically leading countries in conquering space, we may expect the actual building of a lunar base within five to ten years. This means that design and research covering the selection of proper structures and materials should start now. This article is based on the writer's research experience in this field.

Since the advantage of establishing a temporary or permanent lunar base is not too evident, it should be discussed briefly. The complete lack of atmosphere on the moon permits the construction of an astronomical observatory there capable of reaching many times deeper into the universe than we are able to do from the Earth.

Neighboring planets, such as Mars and Venus, could be better analyzed. The lunar base could serve also as an intermediate station for interplanetary flights, since it is markedly less difficult to reach the moon than any planet of our solar system. Because of the smaller lunar gravitational pull, a space-ship with the same thrust can carry a larger payload into the universe from the moon than from the Earth. The Earth could be observed very closely from a lunar base, yielding important meteorological forecasts, and military supervision.

The structural design of a lunar base is influenced mainly by three factors: (1) the final purpose of the structure, (2) the special lunar conditions, and (3) the construction materials to be used.

The purpose of the structure largely determines its size. The first exploratory activities would be carried out over a limited area. These operations would be conducted, undoubtedly, with the landing vehicle serving as a base, thus rendering unnecessary the solution of any additional structural problems. Because of the limited supplies of air, food, water, and other necessities that could be carried by a man-operated space-ship, the establishment of a more permanent lunar base, with self-sufficient living quarters, workshops and scientific laboratories would be highly desirable.

The material for such a prefabricated structure would have to be transported by space-ship. Prefabrication would permit erection with a minimum amount of work at the site. The best prediction at present indicates that the final lunar colony will be housed in large underground buildings, if investigation and research of the lunar rocks and soils indicates the possibility and feasibility of such structures.

Lunar conditions

In spite of the relatively short distance between the earth and the moon, our present knowledge of the moon is insufficient to allow us to definitely know all the lunar conditions. The special lunar conditions influencing the structural design can be summarized in the following seven items:

1. Reduced gravity
2. Lack of atmosphere
3. Extremely large temperature changes
4. Composition of the lunar soil
5. Increased hazards from meteors
6. Seismic loads
7. Shielding against cosmic solar radiation.

The reduced gravity means merely the reduction of all loads, caused by the lunar gravitation, to one sixth of their terrestrial value. Such a weight reduction may result in a lighter, more economical structure. Extremely light structures, however, possess a higher degree of elastic instability against buckling, tilting, etc., and an increased tendency toward undesirable vibration. This problem should be investigated by the designer very carefully. If weights are required for counterweight action against overturning, as in the case of gravity retaining walls and cranes, then the reduced gravity does not offer any advantages.

The complete lack of atmosphere creates more structural problems than the reduced gravity does. All buildings in which terrestrial living conditions are to be simulated will require pressurization, which means complete covering with an air-tight material. The utilization of three-dimensional space structures is almost mandatory (that is, structures in which the external load is carried by three-dimensional internal stresses) because their shape lends itself best to pressurization and offers remarkable structural advantages as well. To meet emergency situations produced by a sudden loss of pressure, independent pressurized compartments are highly desirable.

The lowest atmospheric pressure in which a human being is able to live for any length of time without the use of a space-suit is in the vicinity of 5 psi. For design purposes, 10 psi might be considered as a satisfactory value. Naturally, pressures above that of the normal atmosphere (14 to 15 psi) are also endurable for human beings without special provisions, but from the structural point of view, pressurization at normal or below normal pressures is desirable.

The high pressure difference between the inside and the outside of the structure, coupled with the unknown properties of the lunar soil, calls for a self-contained structure that will not need a heavy anchorage. Moreover, a self-contained structure would reduce foundation problems if, as one hypothesis states, the surface of the moon is covered with a light lunar dust, fine sand or similar problem-causing materials. The lack of atmosphere does not automatically exclude the use of welding for structural connections. Actual tests show, for example, that welding of aluminum alloys by means of helium or argon is entirely feasible, provided that there is some means of cooling the welded surfaces by a neutral gas jet to reduce the undesirable thermal stress concentration.

An extremely wide range of temperature and high differential temperatures create severe structural problems. It is calculated that, on the moon, structures or parts of structures exposed to sunlight might reach a temperature of 280 deg F. In the shade, on the other hand, structural members might have a temperature close to — 150 deg F. The external surface of a structure absorbing a large amount of the sun would have a much higher temperature than the internal surface, where normal terrestrial room temperatures should prevail.

The use of heat-reflecting material or paint should help to a certain extent but consideration should be given to the fact that extreme heat variations (in the neighborhood of 400 deg F) might affect the physical properties of the materials, reducing their ultimate strength considerably, changing their modulus of elasticity and, assuming a large cycle of temperature change, producing thermal stress fatigue. Materials that are poor heat conductors must be eliminated since uneven temperature changes would induce unreasonably high thermal stresses; but to secure even room temperatures, materials with good thermal insulation characteristics are required. These conflicting demands can be satisfied by the use of a double-skin shell structure, stiffened by meridional and ring or honeycomb members to provide an enclosed structure.

The external skin would act as a bumper against meteorites and heat, at the same time increasing considerably the elastic stability and the natural frequency of the structure. For external and internal heat-control, the circulation of a fluid between the two skins offers much promise, although the mathematical solution of heat conduction between a solid and a liquid with variable non-linear boundary conditions is highly complex.

Our knowledge regarding the composition of the lunar soil rests only on hypotheses, one of which states that, since the moon and the earth originated from a common source, the composition of the lunar rocks is largely the same as that of their terrestrial counterparts. Terrestrial rocks are divided into three groups—igneous, sedimentary and metamorphic. According to this theory, it is unlikely that any sedimentary rocks, which are formed by weathering of igneous rocks, will be found on the moon.

Another theory contradicts the first, assuming that part of the lunar surface may be of loose aggregate with a large percentage of extremely light dust. The erosion responsible for this condition is said to be caused by a number of factors inherent in specific lunar conditions, among them the extreme temperature variations, intensive solar X-ray radiation, and continuous bombardment by micro-meteorites.

The third theory, a compromise between the two stated above, assumes the presence of lunar dust, but states that the outermost part of this dust is a metamorphic crust. Since critical structural problems would be created by the presence of an extremely light lunar dust, to be on the safe side, this theory must be considered in the design of a lunar base. While there is a difference of opinion with regard to the existence and origin of the lunar dust, all theories agree on the presence of igneous rocks formed by the solidification of magma. An investigation of meteorites that might have a solar or outer-space origin reveals metallic and stony ingredients. (See Dr. T. Gold, "The Lunar Surface," Monthly Notices, Royal Astronomical

The surface of the moon as seen from earth. For designing the first lunar base, the surface was assumed to consist of a substantial depth of light lunar dust. Added research is needed to determine the actual composition of the surface.

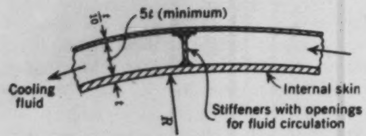


FIG. 1. A double-wall shell, shown in cross section, will provide the recommended lunar base structure with protection against meteoroids. The opening between the two walls will be used for the circulation of a cooling fluid.

Society, 1956; A. Firsoff, "On the Structure and Origin of Lunar Surface Features," Journal of British Astronomical Assoc., 1956.)

A closer investigation indicates that the density of the Earth is about 5.0 to 5.5, whereas that of the moon is between 3 and 4. This difference in densities points to different origins for the moon and the earth, indicating that the moon was captured from outer space by the Earth after the solar system was already in existence. Although the lunar rocks may be quite different from the terrestrial ones, they also were formed by the condensation of gaseous materials. Extensive local research on the moon will be required before the lunar rock can be utilized as a building material for surface or underground structures.

Another important item to be considered as part of the specific lunar environment is the meteor hazard. An effort to design a structure that would withstand the impact of large meteors appears as unreasonable on the moon as it is on the earth. Provision should be made, however, to eliminate the hazards produced by the puncturing effects of micro-meteorites, which literally rain on the lunar surface. One of the best safety precautions against meteoric penetration is the previously mentioned elastic double-skin construction, which offers other structural advantages.

Because of the velocity of the meteoroids involved, which is of an extremely high order of magnitude, and because of the lack of atmosphere, in most cases explosion rather than deflection of the meteoroids will occur. The main purpose of the outer skin, or "meteor bumper", is to create such explosions. The "meteor bumper" will prevent the puncturing of the structure by meteoroids up to a certain size (1½ to 2 in.). The thickness of the outer layer can be less than that of the inner skin. A typical section through the double-wall shell is shown in Fig. 1. The space between the two layers should be at least five times the thickness of the inner skin.

TABLE I. Mechanical and physical properties of beryllium

Property	Value
Purity, in percent	99.96
Density, in grams per cu cm	1.816
Linear coefficient of thermal expansion, per deg C	17.8×10^{-6}
Tensile strength, in psi	30,000
Modulus of elasticity, in psi	40×10^{6}
Specific gravity at 20 deg C	1.85
Thermal conductivity at 20 deg C, in cal per sq cm per deg C per sec	0.385
Specific heat, in cal per gram per deg C at 20 deg C	0.425
Hardness (Brinell)	60 to 98

All the hypotheses regarding the moon's origin and surface agree on the presence of igneous rocks, that is, solidified magma, regardless of origin, whether solar or from outer space. This magma shrinks as it cools from its original molten state, and external surface layers that were previously in equilibrium must collapse. It is therefore reasonable to assume that structures of a permanent nature on the moon will be affected by seismic motion. Again the three-dimensional space structure qualifies better than any other type. For instance, a properly designed double-curved shell structure possesses so much "reserve strength" as to be practically indestructible.

Shielding against solar and cosmic radiation is as yet an open question, since the amount, and part of the composition, of outer-space radiation are unknown. One of the purposes of the Explorer missiles and satellites is to determine these unknown factors. There is a relationship between solar and nuclear radiation since solar radiation is a type of nuclear radiation consisting of alpha rays (the effect of which is similar to X-rays), neutrons and beta rays. All the rays are absorbed to some extent in their passage through any material.

The decrease in the intensity of the radiation depends largely on the density of the material through which the rays pass. Shielding can be achieved by a proper amount of liquid (which is needed for other purposes, such as cooling of surfaces), circulated between the skins. The computation of the required thickness can follow the general path required for shielding against nuclear radiation. (See Dr. S. Glasstone, "The Effects of Nuclear Weapons," U. S. Government Printing Office, Oct. 1957; and R. Szilard, "Design of Underground Structures for Atomic Blast Loads," Bulletin of Eng. Experiment Station, Univ. of Utah, 1959.)

Construction materials will be needed that will offer high strength, will reflect heat to a large extent, will be light in weight, will not lose strength dangerously at high temperatures, and will have a good corrosion resistance and relatively good thermal conductivity. A survey of the available materials indicates the possible use of the following group of metals—beryllium, tungsten, tantalum, molybdenum, chromium, vanadium, and niobium. (See H. R. Ogden, "Future Metals," *Chemical Eng. Progress*, Vol. 54, no. 11; and S. L. Hoyt, "Metal Properties," ASME Hanbook, 1954.)

Of these materials, in the writer's opinion, beryllium offers the most promise. It has a stiffness coefficient six times greater than the conventional structural aluminum used in aircraft and missile design. It is three times better with regard to buckling strength, and twice as good in tensile strength as compared with structural aluminum alloys. Its potential advantages for use in lunar structures include low porosity, high corrosion and erosion resistance, good weldability, resistance to magnetic-field effects and to thermal shocks and fatigue. At present, the only structurally undesirable property of beryllium is its low ductility. Additional metallurgical research in alloying it with other base metals is required to remove this drawback. The mechanical properties of beryllium are tabulated in Table I.

At the present stage of biological research, natural sunlight is required for the function of hydroponic (soilless) garden beds, or photosynthetic gas exchangers required to provide food, oxygen and other important items for an entirely self-sufficient lunar home. This requirement imposes severe restrictions on the structural design of a lunar-base structure since a significant part of the external structure should be transparent, causing problems of local stress concentration, connection and discontinuity. One of the purposes of the lunar housing simulator (shown in an accompanying photograph) is to facilitate research in the biological field under simulated lunar conditions in order to investigate the potential use of artificial light for biological purposes.

The most desirable transparent materials are high-quality temperature-resistant glasses. Annealed aluminosilicate glasses can be used up to 1,400 deg F, assuming a long-time exposure, whereas, "fused silica" glasses can be used up to 1,800 deg F for long-time and up to 2,500 deg F for short-time exposure. Both types possess a desirable low coefficient of linear expansion and high-temperature shock resistance. The ultimate strength of these two glasses depends on the surface condition, and failure will occur in tension. In the near future pyrocerams (transparent ceramic products) should offer new frontiers for transparent and translucent coverings;

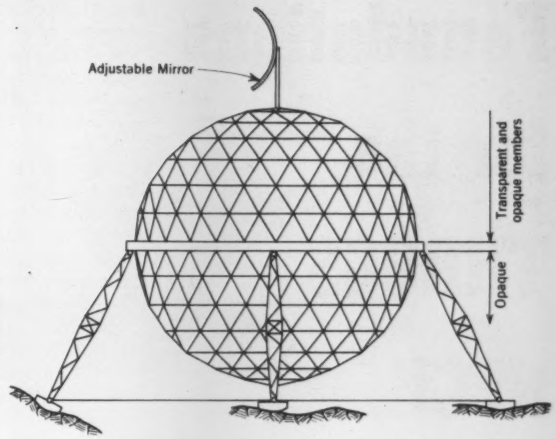


FIG. 2. A recommended prefabricated lunar structure has the form of a sphere supported at the circular edge-beam by four or more adjustable legs.

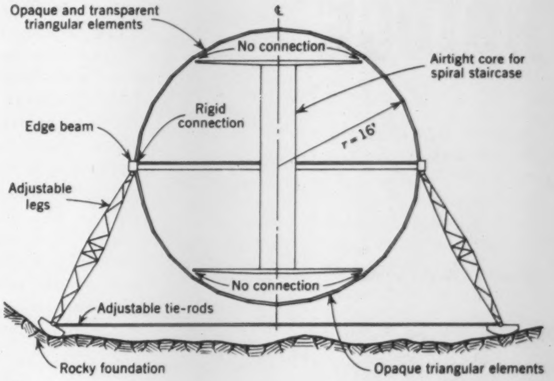


FIG. 3. Schematic section through proposed sphere for a lunar base shows that the internal structure, with its three levels, is completely independent of the external structure.

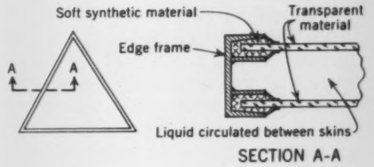


FIG. 4. Transparent elements of the upper part of the structure are enclosed in triangular frames of the same size as the opaque elements.

their application is limited at present by the small fabrication sizes available.

A recommended lunar structure is illustrated in Figs. 2 and 3. It is in the form of complete prefabricated sphere supported by four or more adjustable legs at the circular edge-beam. The purpose of the legs is twofold: (1) on a rocky soil, which might damage the extremely thin double-skin shell, the structure would be supported by the legs; (2) if the lunar soil turns out to be a problem-producing light lunar dust, the legs can be adjusted to a horizontal position, and inflated balloon-type materials between the legs would help the entire structure to float. The lunar house illustrated in Figs. 2 and 3 can accommodate a crew of five with the necessary laboratory and scientific equipment, including plants to provide a self-supporting food- and oxygen-producing "closed biological circuit."

The internal structure, with three levels, is independent of the external structure. Support is provided at the second-level floor (Fig. 3) and the edge-beam in order to avoid undesirable stress concentrations in the shell at the connection between internal and external strucures. In case of an emergency caused by a sudden meteor puncture, the airtight cylindrical shell of the core will serve as a pressure chamber which can be reached and sealed in a matter of seconds. Then the crew, putting on their space suits, can repair the damage.

Both the upper and lower parts of the sphere are made of identical triangular or hexagonal elements fabricated to a very close tolerance. The parts below the circular edge-beam are opaque. The transparent elements of the upper part are enclosed in triangular or hexagonal frames of the same size as the opaque elements (Fig. 4). The first design approximation can be based on the membrane theory, giving due attention to the moment disturbances at the partially fixed boundary (the edge-beam) and analyzing the stress concentration at the transparent openings. It is expected that the final structure will require only a limited amount of transparent openings. For the final structural analysis, the method of "finite differences" is recommended, utilizing electronic computers for the solution of the large number of simultaneous equations involved in this type of numerical analysis.

The lunar housing simulator shown on p. 46, in which lunar conditions are simulated as closely as possible, will serve many purposes. It will be erected next year on the grounds of the 21st Century Exhibition in Seattle, Wash. In the intended course of its evolution the first structure, composed of a shell and a ribbed dome, would serve the purpose of a psychological research project involving the crew, coupled with a mechanical research project covering the function and configuration of the required machinery and equipment.

In the photograph of the simulator, that part of the entrance tunnel which is outside the reinforced concrete pressure chamber will be constructed of reinforced concrete (10 ft in diameter and 6 in. thick) and will rest on terrestrial ground. That part of the entrance tunnel and the main airlock which are inside the reinforced concrete pressure chamber will be made of welded structural steel (7 ft in diameter and 5/16 in. thick), supported mainly by the inside core and partially by the ground.

On the moon there will be no entrance tunnel outside the structure and the core will serve as the airlock. It will not be possible to go directly into the working area. The entrance will lead to the airlock, from which the central core will be entered.

The final structure here described, and illustrated in Figs. 2 and 3, must be such that it can be completely erected in a vacuum by the crew, wearing space suits, under extreme temperature changes simulating lunar conditions as closely as possible, with the exception of the reduced gravity. It should also be mentioned that all power requirements will be provided by electricity generated by solar or nuclear energy.

The writer wishes to express his appreciation to the Denver Division of The Martin Company, and especially to G. M. Galmish, Principal Engineer, and Dr. J. Gaume, Chief of the Space Medicine Section, whose cooperation was of great help in the preparation of this article.

Foundations for the THROGS NECK BRIDGE

NOMER GRAY, F. ASCE

Partner, Ammann & Whitney

Consulting Engineers

New York, N. Y.

Throgs Neck Bridge, connecting the Boroughs of the Bronx and Queens in New York, has foundations that are quite impressive. The anchorage caissons for the 1,800-ft suspended span are believed to be the largest in the world, that for the Queens end having a plan area of 146 by 226 ft. Throgs Neck Bridge will be the fifth and most easterly Triborough Bridge and Tunnel Authority crossing of the East River. Other crossings are the Whitestone and Triborough bridges and Queens-Midtown and Brooklyn-Battery tunnels.

The new bridge, including approaches, has a total length of 12,000 ft. The bridge toll plaza and administration area will be located at the Bronx end. Toward the north a two-pronged connection will be built as part of the Interstate Highway System with federal and state highway funds by the New York State Department of Public Works. One leg will be an extension of the Cross-Bronx Expressway from its present eastern terminus at Hutchinson River Parkway. The other leg, Throgs Neck Expressway, will run to the northeast to connect with Bruckner Expressway and the New England Thruway.

On the Queens side the bridge will connect with the Cross Island Parkway and, via the new six-lane Clearview Expressway of the Interstate System, with east-west arteries as far south as Hillside Avenue. The interconnected expressway system—Clearview, Long Island, Brooklyn-Queens and Gowanus expressways—will accommodate mixed traffic, particularly from Brooklyn and Queens, on smooth express roads bypassing the city streets.

Throgs Neck Bridge has been under construction since October 1957 and is scheduled for completion early in 1961. In mid-September the foundations for most of the structure were nearing completion. Anchorages were being concreted, the 323-ft-high tower on the Bronx side was topped out, and the Queens tower was half finished. Engineering design and construction of several parts of the bridge are of interest. This article features the foundations for the anchorages and for the tower piers of the suspended span, Fig. 1.

The design of deep bridge foundations must take into account construction requirements as well as permanent loads. These considerations led to the use of reinforced concrete caissons for the pier and anchorage foundations. These caissons are perforated vertically by dredge wells for sinking. For each of the two tower piers the caisson had 36 wells 14 ft in diameter. At one anchorage, the caisson had 70 dredge wells of 16-ft diameter, and at the other anchorage, the caisson had 77 wells of 16-ft diameter.

These four caissons present interesting contrasts in the construction techniques used by three contractors. Because of the water depths at the towers, a floating steel caisson was the logical selection at these sites. In the shallower water at the anchorages, the sand-island method was logical and was used by both contractors, with striking individual differences however.

The floating steel caisson may be described as a watertight rectangular box perforated vertically by circular openings, to which are attached open vertical steel cylinders whose tops are always above water. These cylinders are the dredge wells through which the material penetrated in sinking is removed—either by crane and bucket or by airlift. Spaces between the dredge wells and around the periphery of the box are filled progressively with reinforced concrete, thus increasing the weight of the caisson and causing it to sink. For example, the caisson for the Bronx tower pier was planned to be fabricated to a height of 68 ft at a welding plant and floated 30 miles to the bridge site, with 23 ft submerged, and 46 ft of freeboard.

To secure this floating caisson in position to resist wind and tide, three structural-steel frames known as "mooring cages" were set on the river bottom with their tops projecting 20 ft above low water. The frames were made largely of pipe (see photo) with some of the pipe designed as guides for H-piles to be driven to hold the frame in position. The cages were placed at the centers of the two long sides and one end of the caisson to form a dock into which the caisson was floated. Once the caisson was inside, the open end was closed by the driving of verti-

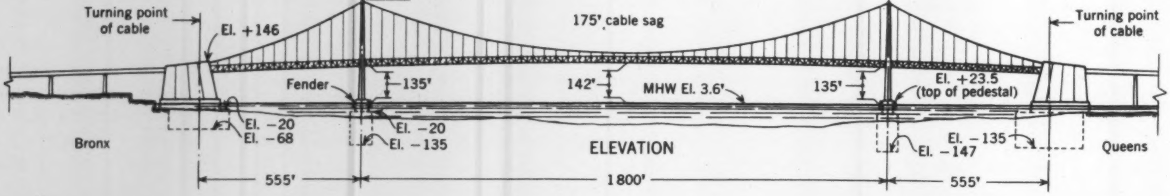
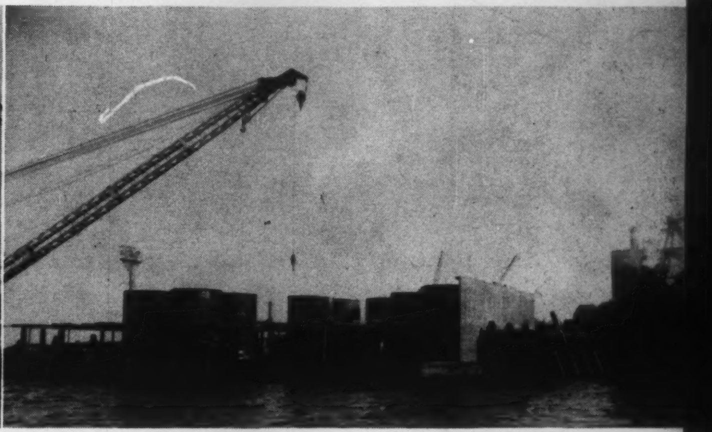


FIG. 1. Suspended span of Throgs Neck Bridge. Overall length of the bridge is 12,000 ft.

Derrick boats set a mooring cage to position a floating caisson for the Bronx tower of Throgs Neck Bridge.



Mooring cage holds caisson in position while its height is extended by setting steel for dredging wells and exterior walls.

cal and batter piles which were welded together to form a frame. The clearance between the bumper blocks on the cages and the sides of the caisson was about 2 ft.

By placing concrete in the caisson, exclusive of the open wells, the floating box was sunk until it reached river bottom at EL.−53. With a buoyancy of 203.4 tons per vertical foot, the caisson required 100 cu yd of concrete at 156 lb per cu ft to sink it 1.03 ft. The concrete was mixed in a floating plant containing two 2-cu yd mixers discharging into a holding hopper. It was transported in 4-cu yd buckets, handled by either of two floating cranes from the hopper to the caisson, and was placed through pipes extending downward from funnels positioned at the top of the caisson. Under good conditions, a placement rate of 100 cu yd per hour was achieved.

Because of the soft nature of the organic silt bottom, it was possible to sink the caisson for the Bronx tower pier into the silt about 5 ft under its own weight without excavating—to El.−58. This silt has an average moisture content of about 95 percent and is some 62 ft thick. As the caisson sank, the beveled inside faces of the steel cutting edges forced the silt first into the caisson chamber and then into the dredge wells. The cross-sectional area of the dredge wells equaled about 46 percent of the base of the caisson.

A condition of equilibrium was reached when the excess weight of the caisson over buoyancy was balanced by the side friction inside and outside, plus the small bearing value of the silt under the cutting edges and shoulders in the caisson chamber. To sink the caisson further, it was necessary to add weight by placing more concrete or to reduce resistance by excavating in the dredge wells.

In sinking it was of course always necessary to maintain a freeboard at the top. This was done by progressively building up the steel walls of the caisson and of the dredge wells. Prefabricated steel panels about 75 ft long by 18 ft high were set around the exterior, and "cans" of the same height were welded on to extend the dredge wells.

Since a switch from any one operation to another involves expense and lost time, each operation was planned to continue until some physical limitation necessitated stopping it. In dredging, the limitation might be the removal of material too far below the cutting edge if the box was "hung up;" if it was sinking too easily, excessive water pressure might develop against the unbacked caisson steel. In concreting, the limitation might be the placing of weight too high above the river bottom, tending to cause instability. In building up the caisson sides, the limitation might be restriction of derrick operations caused by the boom striking the caisson sides.

For the Bronx tower caisson, sinking to founding level at El.−135 was accomplished in six "sinks," which varied in depth from 9.9 to 20.5 ft. For excavation, either two or four floating derricks were used, and 2- and 3-cu yd buckets loaded the excavated material into barges to be towed to a suitable disposal area. The rate of excavation per derrick-hour varied tremendously with the material being penetrated.

When the planned bottom was reached, the excavated material was carefully examined by bucket loads and the soil below checked by means of borings. The Bronx tower pier is founded on a combination of sand and disintegrated rock. The bottom was leveled carefully by bucket and airlift to a plane very close to the cutting-edge elevation and examined by divers. Then the caisson chamber was filled with tremie concrete. The tremie concrete

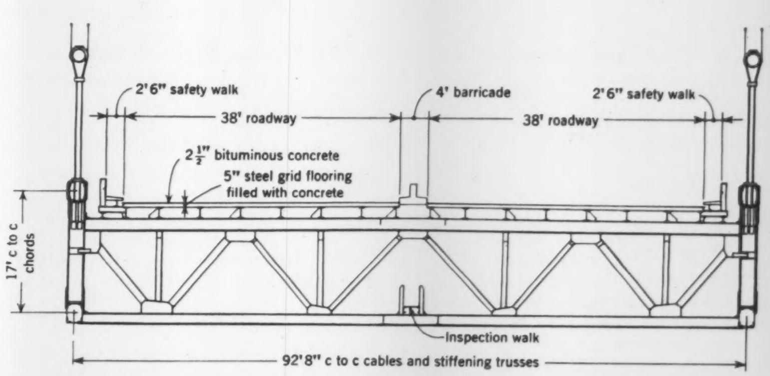
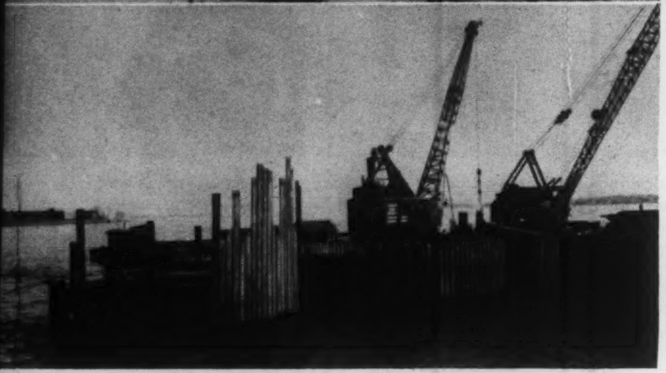

2'6" safety walk
4' barricade
2'6" safety walk
38' roadway
38' roadway
$2\frac{1}{2}$" bituminous concrete
5" steel grid flooring filled with concrete
17' c to c chords
Inspection walk
92'8" c to c cables and stiffening trusses

FIG. 2. Roadway, seen in section, is designed for three high-speed lanes of traffic in each direction.

An L-shaped cofferdam enclosed the Bronx Anchorage inside an existing seawall. The first lift of concrete on the steel cutting edge is being placed.



Sheetpiles are positioned around circular template. H-piles support the template temporarily until sand has been placed to stabilize cells, then both H-piles and template are moved ahead.

was placed first in the middle third of the caisson and then successively in the two end thirds, with an interval between pours so that possible subsidence could be observed. In sinking the caisson, the bearing area was deliberately kept small, so that it consisted only of the peripheral cutting edge and two intermediate cross-walls. To minimize further movement, cleaning was confined to that third of the caisson chamber in which the tremie concrete was to be placed, leaving cleaning in the remainder until just before concreting.

Placing the tremie concrete developered the bearing area of the entire caisson, 162 x 75 ft. Concrete was brought up only a short distance into the dredge wells. Water remained in the wells during construction and will stay there during the life of the structure, in place of concrete, thus reducing the load on the foundation.

The circular dredge wells were closed by setting precast circular slabs into their tops. A distribution slab of reinforced concrete 4 ft thick extends over the entire top of the caisson, covering the dredge wells and providing a support for the two pedestals and connecting wall of the pier, which extends 23 ft above the water.

Throughout the construction period, the exterior walls of the caisson were kept high above the concrete and well braced to serve as a cofferdam. This permitted placing the distribution slab and pedestals in the dry. The cross bracing and the exterior shell were removed to El. −20.

The bearing surfaces at the tops of the pedestals were poured about ¼ in. above the design elevation and ground to a horizontal plane to receive the bases of the steel towers. The entire operation of constructing the Bronx tower pier required from March 10, 1958, when the first mooring cage arrived, until April 9, 1959, when the pedestal bearing surface was completed. The Queens tower foundation was built similarly, in the period between April 15, 1958 and June 1, 1959.

Bronx anchorage

The method of constructing the anchorage caissons was markedly different. The Bronx anchorage, being adjacent to the shoreline and in fairly shallow water, was built on a sand island enclosed within a cofferdam consisting of 13 cylindrical cells, each 55 ft in diameter. Because of the curving shore line, the "island" could be enclosed in an L-shaped cofferdam. At the deepest corner, the water is 29 ft deep. As the cofferdam was being completed, a dredge pumped sand from a point in the river bottom about 1,000 ft away to fill the enclosure to El. 0, mean low water.

A well-point system was installed along the inside edge of the cofferdam to lower the water to El. −7.0. The tide in this area varies from +5.0 to −3.0, with an extreme high of +9.0. The sand island was trenched to El. −7.0, and a structural-steel cutting-edge section 7 ft high was set into the trench with the cutting edge resting on the bottom of the trench. In the first stage, the caisson was built up of reinforced concrete to a height of about 33 ft, the first lift being 7 ft, the second 6 ft, and the rest about 4 ft 1 in. The exterior forms were metal panels cantilevered from the previous pour and tied in with inclined tension ties. The dredge wells were formed with specially fabricated metal cylinders whose diameter could be slightly reduced by screws to facilitate stripping.

This first-stage height of 33 ft was set by the contractor as the practical minimum to resist the stresses induced by probable unequal support in the sinking operation. At this stage of construction the Bronx anchorage foundation consisted of a newly poured concrete slab 146 x 206 ft in plan, perforated by 70 dredge wells 16 ft in diameter. To induce sinking it was necessary to reduce the support offered by the sand under the two transverse and the two longitudinal cross-walls and under the entire peripheral cutting edge. To obtain a sagging condition (that is, to induce in the caisson the positive moments for which this stage was designed), a dredging pattern was

Major Construction Contracts for Throgs Neck Bridge

Job	Contractor	Amount	In Charge at Site
Tower substructures	Merritt, Chapman & Scott	$ 7,490,790	Jack Denny
Bronx anchorage	Fehlhaber Corp.	7,103,705	Aaron Burros
Queens anchorage	J. Rich Steers, Inc. & Frederick Snare Corp.	10,407,350	Earl Larsen
Towers and cable-anchorage metalwork	Bethlehem Steel Co.	10,129,119	Harry Howell
Cables and suspenders	American Bridge Co.	6,258,339	....
Suspended span	American Bridge Co.	9,150,970	....
Approaches designed by E. Lionel Pavlo, consulting engineer			
Bronx Approach and Queens Approach substructures	Water: Merritt, Chapman & Scott	7,191,290	Jerry Martin
Bronx Approach superstructure, steel	Harris Structural Steel Co.	5,533,360	....
Queens Approach superstructure, steel	Bethlehem Steel Co.	5,626,304	....

established which tended to produce a dished bottom, concave upward. The support provided by the bottom varies from full support, through partial to none whatever, depending on the nature of the material and the depth of embedment of the caisson cross-walls.

To avoid overstressing this large concrete slab, a series of level readings were made on points set in the top surface of the caisson during dredging. Special techniques for leveling had to be developed because the caisson was moving slightly as the readings were being taken. The stresses were computed from observed deflections. Some idea of the stiffness of the slab may be gained from the fact that deflections of 2 in. in the 206-ft length would produce dangerously high stresses in the steel.

The variations in caisson support by the bottom were complicated by variations in the density of the material excavated. Either long experience in this type of excavation, or very close observation plus intuitive understanding of the behavior of the box and very close field control of the crane operators, was necessary to minimize the danger of cracking the caisson, especially during the first excavating stage, which followed the first concreting stage. At this shallowest of the foundations (bottom was at El. −68), the sinking was accomplished with two concreting and two excavating stages.

The equipment for constructing the Bronx anchorage was located on the sand island. Excavation was done by four crawler cranes with 1½-cu yd clamshell buckets discharging into 10-cu yd trucks. The trucks hauled the muck a short distance to the water's edge, where it was conveyed to barges and towed away. A temporary plant was set up on the sand island to dry-batch materials into 9-cu yd transit mixers. These hauled the concrete the short distance required to each of four cranes, which placed the concrete in the caisson using 2- and 3-cu yd concrete buckets. This extremely flexible and economical plant could place 120 cu yd per hour under normal conditions. All concrete materials were delivered to the sand island by barge except the mixing water, which came from a nearby city water main.

Queens anchorage

The Queens anchorage foundation presented a very difficult problem, being located about 500 ft offshore in water varying in depth from 45 to 30 ft. Here the cellular cofferdam was a closed rectangle 360 by 266 ft in outside dimensions. It consisted of 18 cells each 49.3 ft in diameter, and connecting arcs, enclosing a sand island whose surface was planned to be at El. −20.0.

Corner of the cutting edge for the Queens Anchorage is seen in place. The actual "edge" is a heavy angle. Interior walls are sloped 1:1 to a point.

Steel forms and reinforcing are in place ready for pouring a lift on the Queens Anchorage. Forms are removed before dredging is done.

The selection of this surface elevation was intended to reduce the amount of sand to be placed inside the cofferdam, which also of course would reduce the excavation necessary to sink the caisson. The question was, whether, considering the sand of the river bottom and the coarse sand to be placed within the cofferdam, a well-point system could lower the water level inside the cofferdam so that the caisson could be constructed in the dry. With a minor adjustment up, from El. −20 to −18, a two-stage well-point system did the job.

Work was started by constructing in the water two 10 x 10-ft survey platforms south of the future cofferdam, on the prolongation of the center lines of the cofferdam cells. With this control, wood piles were driven to support a circular template for the first cell, which was set by a floating derrick. Steel sheetpiling was then driven around the template and the cell, of 49.3-ft diameter, was filled with sand to El. +8.0. After three adjacent cells and connecting arcs had been constructed and filled with sand, a crawler crane was placed on the cells. The crawler crane and the floating derrick constructed the remaining cells, moving the template ahead and clamshelling in sand.

As soon as a sufficient number of cells were finished to form a protective wall, sand was placed within the partial enclosure by floating in bottom-dump sand scows. The delivery rate of this sand was so controlled that most of the sand had been deposited by the time the last cells were being placed. This avoided the placing of much sand by the less efficient method of crane and bucket. The first template was placed Feb. 27, 1958, and the eighteenth cell was completed on May 5, 1958.

To avoid the formation of channels by upward flow of water through the enclosed sand, the entire cofferdam was dewatered by a well-point system. When the sand island was dry, the structural steel sections of the cutting edge were placed on it, and the caisson built up, as described for the Bronx anchorage. Two fixed structures were supported on steel piles driven through sand in the cells. These were a large stiffleg derrick, with a 150-ft boom of 12-ton capacity, and a concrete plant. To serve these, power cables and a water line were laid from the shore to the cofferdam.

The concrete plant was a large one, with two 3-cu yd mixers and a continuous-belt feed to load the aggregate bins. The plant's capacity of 150 cu yd per hour exceeded that of the concrete handling equipment. Four large crawler cranes worked from the top of the cellular cofferdam. These, with the stiffleg derrick, handled the concrete from mixer to caisson. To reach certain parts of the caisson remote from the concrete plant, the "lay-down" concrete buckets had to be passed from one crane to another. Excavation to sink the caisson was done by the same four cranes and stiffleg derrick.

For this caisson, which was sunk to a cutting-edge depth of El. −135, there were four concreting stages. Placing of the cutting-edge was started on June 18, 1958, and it reached founding elevation July 9, 1959. The final position was only 4 in. from the exact center, and the departure from level only 7 in. diagonally.

The rate of sinking varied from a maximum of 3 ft per 24-hour working day to a minimum of 2½ in. The slowest progress was not at the very bottom but rather in the stiff clayey silt layer between El. −95 and −115. Here the material was so hard that the bucket tended to excavate a conical hole under each dredge well, leaving dense walls of material supporting the roof of the caisson chamber between the dredged areas. Since water could not permeate this material sufficiently to soften it in a reasonable time, it was necessary to break the walls down with pressure jets suspended in the falls of a crane.

Big jet used

The vertical pipe was of 10-in. diam. to supply the considerable amount of water needed for a 1-in. jet, and another jet of the same size opposing it, to counteract the tendency to move away from the work. When it is realized that these horizontal jets had to be worked "in the blind" at a depth of 120 ft, some conception may be had of the difficulty and inherent slowness of this operation. Although it was not necessary to use these jets in all 77 of the dredge wells, about 20 of the southeast wells had to be so treated. Caisson weight was increased by pumping down the water inside the cofferdam to El. −12 to reduce buoyancy. Side friction was reduced by the use of water jets from nozzles embedded in the caisson walls near the bottom.

Throgs Neck Bridge is scheduled for opening in the spring of 1961. It is being constructed by the Triborough Bridge and Tunnel Authority, whose chairman is Robert Moses and whose general manager is George Spargo, F. ASCE.

The approaches, which are not covered in this article, were designed by E. Lionel Pavlo, F. ASCE, consulting engineer.

The suspension bridge proper was designed and its construction is being supervised by Ammann & Whitney, consulting engineers. The senior partner, O. H. Ammann, Hon. M. ASCE, is in general charge. The design was under the direction of Milton Brumer, F. ASCE, and construction supervision is under the writer, with William Delehanty as Resident Engineer.

A minimum education for professional civil engineers

JOHN B. SCALZI, M. ASCE, Associate Professor of Structural Engineering, Case Institute of Technology, Cleveland, Ohio

In contrast to some civil engineers, I see no crisis in our profession today, but only the natural result of the increased store of available knowledge. Admitting that more knowledge is available, it naturally follows that some of it must be incorporated in the various curricula of study. The civil engineering curriculum is no exception. It, too, must be brought up to date and kept in tune with the times.

As a particular discipline or subject becomes more generally known, it becomes a routine procedure and is no longer worthy of a great deal of time in the curriculum. As new material is developed it is brought into the curriculum and usually a greater amount of time is devoted to it in order to cover the subject as completely as possible. In this way, the new subject becomes better understood and new ideas are brought to bear on it to help develop it further. We happen to be in the midst of a rapidly developing scientific era which affects all branches, and the impact seems to be greatest on the civil engineer and his education.

Basic knowledge has increased and is continuing to increase at a geometric rate. Our civil engineering curriculum has not always incorporated these new findings at a sufficient rate to keep abreast of the times. Therefore we now find ourselves incorporating many of these new subjects into the curriculum all at once rather than gradually and one at a time. As a result, it appears that some engineers are advocating drastic changes in the curriculum whereas in reality they are merely trying to catch up with new developments. The suddenness with which we have been awakened has startled us a bit and thrown us off balance. As soon as we collect ourselves we will all agree that the education of civil engineers has lagged behind the times, that we have kept our sights too close to the drawing board and have not seen the broad overall plan.

Since civil engineering education is considered to be the broadest type, we should concentrate on expanding its areas of influence rather than trying to narrow them. We should not allow others less qualified to take over our areas of responsibility. Let us de-emphasize the many fields of extreme specialization and return to the broad education which civil engineers have traditionally enjoyed and used.

Is the four-year program sufficient?

A great many pages have recently been written on the civil engineering curriculum, but to my mind very few of them approach the problem from the standpoint of the real needs of the professional civil engineer. I have heard and read many different definitions, lists of duties and responsibilities, areas of understanding, and fields of specialization. By itself, the definition of engineering approved by the Engineers' Council for Professional Development does not include the full scope of the activities of a practicing professional civil engineer.

It appears that any discussion of a curriculum should be preceded by a statement of the objectives to be achieved by it. Then and then only can its merits be properly evaluated. Some engineers still maintain that a civil engineer can be "turned out" in a four-year program of undergraduate study—with sufficient specialization to enter professional practice in a particular field. I question the degree to which this goal can be accomplished.

Before expressing my thoughts on a curriculum, I would like to define two types of professional civil engineers, as I have come to know them.

The practicing civil engineer is called on to provide the answer to a particular need (which he may have suggested), to conceive the project in its entirety, to design it as efficiently and economically as materials and costs will permit, to supervise its construction, and to operate and maintain it if necessary.

The specializing civil engineer should possess all the qualifications of the practicing civil engineer and, in addition, be a specialist to the *n*'th degree in one or more specific phases of his field.

Since both types require the same basic knowledge, only the broad base will be considered in the subsequent discussion.

It is evident that a civil engineer is called upon to do many related tasks requiring a varied background in science, mathematics, engineering in general, and economics. Formerly it was the practice to assign structures individually to different firms. But now more and more projects are being assigned as a whole, that is, one firm may be called upon to design the entire project with all its parts, such as highways, bridges, culverts, and buildings.

A civil engineer in charge of the development of a steel mill or an oil refinery must coordinate all the interrelated specialties into an efficient system. For example, in the case of a steel mill, the project engineer in charge must not only understand but must direct the efforts of many different types of engineers. Such a project will involve structures, soils and foundations, metallurgy, mechanical and electrical equipment, trade wastes and sanitary facilities of all types. Each specialist should understand the needs of the others and be able to solve his special problems in such a way as to further the efficiency of the project as a whole. It is evident that, if a man is to be prepared to achieve such a goal, his education must be built on a broad base.

Graduate professional schools

Definitely the time is now at hand when graduate professional schools of engineering must be established with specific aims. To provide the necessary background, as outlined above, requires a broad base of general knowledge in many areas, which can best be taught at the undergraduate level. The recommended undergraduate program would cover a four-year period with a major area of professional study, such as civil engineering, in the junior and senior years. The recommended degree would be a Bachelor of Science in Engineering with an added notation such as a major in Civil Engineering.

This type of education parallels the four-year liberal arts program but is naturally based on scientific courses with a major area of study in engineering, similar to a liberal arts program with a major in mathematics. This program will be sufficient for great numbers of students who prefer a science course as an area of study, with some knowledge of a general area of specialization. Many industries will employ such graduates just as business firms employ liberal arts students with majors in business administration. There is a definite need for this type of graduate who is educated in science and engineering.

The most eligible graduates will be permitted to continue their studies for two additional years, during which time they will study several related areas and specialize in one or two of them. The degree of specialization in an area will vary with the individual and his personal objectives.

The fifth year may mean the end of their formal education for some students. A degree, if granted at this time, could be a B.S. in Civil Engineering. At this point, the question should be raised, "Do we grant too many degrees in engineering?" Wouldn't we be better off with just one degree beside the doctorate? From a professional standpoint, I think it would be less confusing to the general public as well as to our own members. If we are to maintain a professional status, we must establish basic standards and stick to them.

The successful completion of the sixth year should bring the graduate to the frontiers of knowledge in his chosen field and also provide him with the necessary background for entering professional practice.

The academic degree at this point could be the Master of Science in Civil Engineering, or Civil Engineer, and the graduate should have a wide acquaintance with his specialty and be well versed in several other fields. This is the degree that should be promoted and publicized as the professional degree, and good students should be encouraged to strive towards it and not to stop with the fifth-year degree.

The fifth-year degree should either be eliminated or minimized in importance as far as professional stature is concerned.

The doctoral program may remain as it now is for individuals wishing to enter the research and academic fields, although it could be broadened in scope to include the highly specialized practitioner.

How is goal to be achieved?

After reading this far, some may say that the proposed plan of study is no more than a five-year program for the B.S. degree in Civil Engineering, which is already being offered by some schools. Actually I am advocating the elimination of the B.S. degree in favor of the M.S. in Civil Engineering as the professional degree. This might be changed to the Civil Engineer degree, or some other, but tradition favors the retention of the M.S. designation. I am also advocating the inclusion of a few new courses to develop the professional attitude and knowledge of the student and prepare him for the activities of the business world besides giving him a background for the solution of technical problems. Professional development cannot be overemphasized at this stage of a student's education. In the past, students have been left to their own devices as far as professional development is concerned. In most instances no effort was made to provide for it.

The professional stature of an organization and of the individuals in it are one and the same. The attitude of the individual toward his profession and the time that he is willing to devote to it are reflected in the profession as a whole. Only through the combined efforts of all its members can an organization achieve the goal its members seek.

What of practicing engineers?

Some engineers may feel that if the graduate professional school is accepted as a part of professional training, engineers now practicing will be automatically classified as highly skilled technicians. This is definitely not true. In fact, the result of adopting the professional school idea will be to maintain and to enhance the professional status of all civil engineers. It will mean that the academic programs have recognized the professional stature of practicing engineers.

The degrees granted to the practicing civil engineers of today were considered sufficient for professional status at the time they were conferred. Their recipients will continue to be classified as professional men. The suggested changes in the curriculum are merely to maintain the stature of the profession by keeping pace with today's greatly enlarged fields of knowledge.

The ASCE through its members can achieve true professional status by adopting professional educational standards for civil engineers. The program should be universally adopted by the members of ASCE, and those schools that wish to be recognized as professional should announce their new programs simultaneously. We can succeed only if we are united in our efforts and goals.

I have intentionally discussed only the general philosophy of a civil engineering education here, and have not tried to pinpoint specific subject content. I believe that the individual schools should adopt programs to meet current and future demands for knowledge as they develop. A good background in general knowledge has always been the tradition in civil engineering curricula, and I am certain that our educators and practicing engineers will continue to favor this type of program.

Formwork is ready (above, left) to receive 1,180 cu yd of concrete for octagonal foundation, which is shared by vessel group and access tower. Structurally, however, the two are completely independent. Foundation is 5 ft 5 in. thick and 77 ft across. Above, right, mobile equipment on the ground is erecting the first 205 ft of access-tower structure.

"Cat cracker" has access tower 265 ft high

J. J. CUNNINGHAM, A.M. ASCE, Civil Engineer, Technical Division, Humble Oil & Refining Company, Baytown, Tex.

Segment of regenerator is being hoisted by double-guyed derrick. Maximum radius of guys was over 1,500 ft.

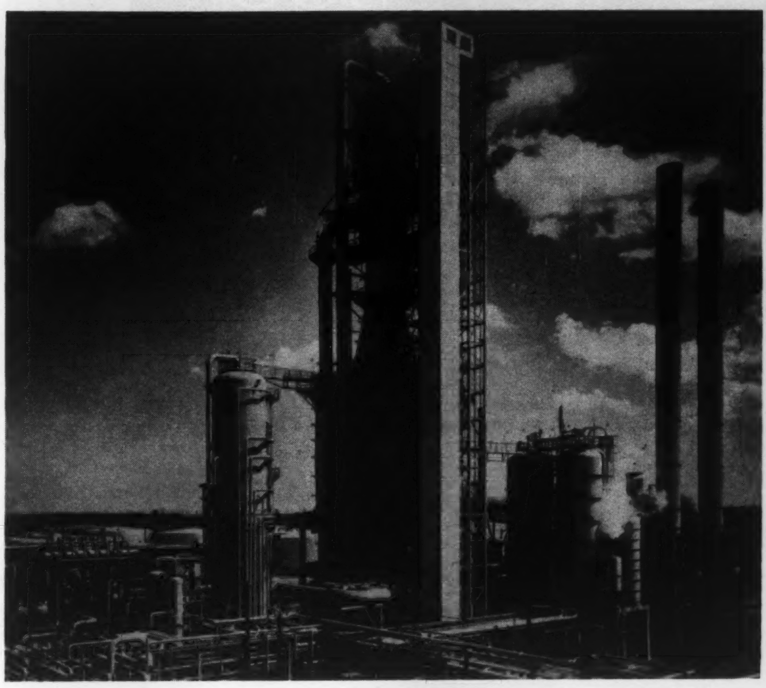
A unique steel structure, towering high above the South Texas plains, affords ready access to all levels of a recently completed fluid catalyst cracking unit. Designed and built by Foster Wheeler Corporation for Humble Oil and Refining Company, Baytown Refinery, the structure measures 20 ft 6 in. by 26 ft in plan, and 265 ft high.

Humble's newest "cat cracker" has many unique design and construction features that set it apart from its sister units. Previous units were built with all the major vessels supported within a structural steel framework. The framework also served as a support structure for access stairs and platforms, elevators, piping, etc. On this latest unit, it was felt that a saving could be realized by stacking the major vessels and making them self-supporting. This raised the problem of convenient access, which was provided by a separate free-standing elevator structure. A shaft covered with corrugated asbestos cement houses the passenger elevator, while the freight elevator runs in an open bay to the right. Numerous platforms extend out to the vessel group, and a stairway goes to the top.

Although not connected structurally, the vessel group and the access structure share the same foundation. This foundation enjoys the distinction of being the largest monolithic pour ever made in the Baytown area from transit-mix trucks. Approximately 1,180 cu yd of concrete were placed in the octagonal foundation, measuring 77 ft across the flat sides, and 5 ft 5 in. thick. Actual placing time was slightly over five hours. Concrete was delivered to the job in 5-cu yd batches from three plants—one in Baytown, another in Pasadena, 17 miles away, and the third in Houston, about 24 miles away.

The outstanding feature of the elevator structure is its extreme slenderness. Since it measures only 20 ft 6 in. by 26 ft in plan, and towers 265 ft high, the ratio of height to least base dimension is 12.9. This extreme slenderness raised several interesting questions. One dealt with vibration, but calculations indicated that the amplitude and frequency were within tolerable limits. Observation of the completed structure to date has indicated that these calculations were correct.

A free-standing elevator tower provides access to all levels of recently completed fluid catalyst cracking unit in Baytown, Tex. Passenger elevator is housed in enclosed shaft at left while freight elevator runs in open shaft at right.



At a height of 205 ft, erection of the elevator tower was temporarily discontinued, and a 160-ft guy derrick was erected on top of it for use in constructing the "cat cracker" unit beside it. Here guy-derrick mast is being hoisted into place.

Another question dealt with the magnitude of deflections that might be encountered by workmen carrying on routine processing and maintenance operations under the expected range of winds. Since structures on the Gulf Coast are frequently exposed to winds of hurricane force, an obvious question was, "What is the maximum deflection that can be expected?" The answer to this one (13½ in. calculated) had a direct bearing on the design of the platforms that connect the elevator structure to the vessel group. The solution was to use hinged platforms, pinned at the edge of the elevator structure, and lapping over the platforms on the vessel group a sufficient amount to insure proper support under maximum deflection. Also, the hinged platforms were rolled concave downward a small amount to offset the difference in thermal expansion between the vessel platforms and the elevator structure, and to insure that there would be no tripping hazard when the vessels are in the hot position.

There also was the question of the operability of the elevators during large deflections, particularly the passenger elevator. Although of course it is not intended that the elevators be used during a hurricane, it is entirely possible that the passenger elevator will be required to operate under a deflection of 3 or 4 in. The elevator manufacturer saw no problem here, and declared that deflections of this magnitude were well within the limits of safe operation.

During August 1958, what appeared to be an excellent opportunity arose to correlate the calculated deflections with field measurements. Tropical storm Ella moved across Cuba and headed directly for the Houston-Baytown area. The writer and several co-workers set up transits in protected locations and took readings on the top of the structure at regular intervals. However, at the last minute, Ella changed direction and lost most of her punch at sea. On the ground the wind velocity never rose above 16 mph during the check, while at the top of the structure it was estimated at 30 to 40 mph. Under these conditions, there was no discernible movement of the structure. The top platform felt as solid as the ground level, and no movement could be detected between the elevator structure and the vessel group.

A maximum steady wind of 66 mph was clocked at grade during tropical storm Debra, in July 1959. No measurements were taken but the structure was observed visually. Although vision was hampered by extremely heavy rainfall, no movement could be detected.

Although designed primarily to give ready access to the main vessel group, the elevator structure also served as a support structure for the 160-ft guy derrick used in the construction of the vessel group. When the elevator structure had reached the 205-ft level, the guy derrick was installed on top of it and remained there until the unit was essentially complete. The derrick was then removed and the structure raised to its present height of 265 ft.

Structural requirements for the guy derrick served to "beef-up" the middle part of the structure, making it stiffer than would have been required for wind loads only. In addition, the structure was designed for the future installation of a stiffleg derrick of 10-ton capacity to be mounted at the top-platform level (250 ft).

ENGINEERS' NOTEBOOK

Determining the lateral deflection and permissible loads on columns

DONALD BREGMAN, formerly Engineer with the Department of Building and Safety, Los Angeles, Calif.

A solution is here presented for the unknown lateral deflection in axially loaded columns, resulting in a general formula for permissible working loads on columns of any material and given type of end supports.

The basic assumptions made here are the same as those made by Euler in deriving his well known expression, $\frac{\pi^2 EI}{L^2}$, for the critical load in long columns. These assumptions are: (1) The ends of the column under consideration are round or pivoted. (2) Shortening of the column length due to compression may be neglected. (3) The column is of uniform cross-section, and hence the shearing forces may be likewise neglected. (4) The maximum lateral deflection occurs at mid-length of the column (when axially loaded and within the elastic limit of the material).

Equation for maximum column deflection

In Fig. 1, let a load P be axially applied to a column having round or pivoted ends, and having its neutral axis not in line with axis X-X, as shown (on account of imperfections in the material, initial crookedness, etc.). The following notations are used:

A = cross-sectional area of column
c = distance of extreme fiber from neutral axis under consideration
d = maximum deflection
E = modulus of elasticity
F = permissible combined unit stress due to both bending and compression
f = factor of safety
I = moment of inertia
k = E, divided by F
L = length of column
P = permissible load on column
r = radius of gyration with respect to neutral axis under consideration
s = unit stress

Designating the distance between end supports along axis X-X by L_1, we may write (applying Euler's expression for P):

$$P = \frac{\pi^2 EI}{L_1^2} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

Since Euler's expression for P is for the critical load and not for the permissible working load, we may write for the latter (introducing a factor of safety, f):

$$P = \frac{\pi^2 EI}{fL_1^2} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (2)$$

from which,

$$L_1^2 = \frac{\pi^2 EI}{Pf} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3)$$

Now let the length of the column be designated by L (taking the length, for all practical purposes, to be that of the neutral axis between end supports, and let the maximum deflection of the neutral axis from axis X-X, at mid-length, be designated by d.

Then, noting that $L/2$ may be taken as the hypotenuse of the right triangle ABC without any appreciable error, we may write,

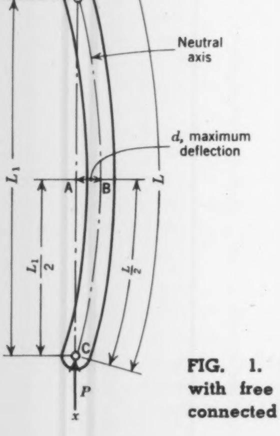


FIG. 1. Column with free or pin-connected ends.

$$\frac{L^2}{4} - \frac{L_1^2}{4} = d^2 \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (4)$$

or, substituting for L_1^2 the expression derived in Eq. 3,

$$\frac{L^2}{4} - \frac{\pi^2 EI}{4Pf} = d^2 \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

from which,

$$d = \tfrac{1}{2} \sqrt{L^2 - \frac{\pi^2 EI}{Pf}} \quad . \; . \; . \; . \; . \; . \; . \quad (6)$$

Applying now the flexural formula $s = (Mc)/I$ for the extreme fiber stress at mid-length of the column, at a distance c from the neutral axis under consideration, and substituting for M its equivalent term Pd, and for I its equivalent Ar^2:

$$s = \frac{Pc}{Ar^2} \cdot \frac{1}{2} \sqrt{L^2 - \frac{\pi^2 E\, Ar^2}{Pf}} \quad . \; . \; . \quad (7)$$

Permissible unit stress

Having derived Eq. 7 for the permissible fiber stress, s, at mid-length of the column (due to the bending moment, Pd), we can now derive a formula for the permissible combined unit stress due to both bending and direct compression. Thus, designating by F the permissible combined unit stress at the mid-length of the column, that is, $F = s + (P/A)$, or $F - (P/A) = s$, we may now substitute for s its expression as derived in Eq. 7, resulting in

$$F - \frac{P}{A} = \frac{Pc}{2\,Ar^2} \sqrt{L^2 = \frac{\pi^2 E\, Ar^2}{Pf}} \quad . \; . \quad (8)$$

Squaring both sides of Eq. 8,

$$F^2 - \frac{2\,FP}{A} + \frac{P^2}{A^2} = \frac{P^2 c^2 L^2}{4A^2 r^4} - \frac{\pi^2 EPc^2}{4\,Afr^2} \quad (9)$$

Transposing in Eq. 9 the terms containing P/A and $(P/A)^2$, the equation becomes

$$\frac{P^2}{A^2}\left(\frac{c^2L^2}{4\,r^4}-1\right)-\frac{P}{A}\left(\frac{c^2\pi^2E}{4\,r^2f}-2F\right)=F^2 \quad \ldots\ldots (10)$$

Noting in Eq. 10 that the terms "1" and $2F$ (inside the parentheses) are relatively very small as compared with the respective terms $\frac{c^2L^2}{4\,r^4}$ and $\frac{c^2\pi^2E,}{r^2f}$ and hence can be dropped without any appreciable error, and substituting kF for E, the equation reduces to

$$\frac{P^2}{A^2}\left(\frac{c^2L^2}{4\,r^4}\right)-\frac{P}{4\,A}\left(\frac{c^2\pi^2kF}{r^2f}\right)=F^2 \quad . \ (11)$$

Finally, solving Eq. 11 by use of the quadratic equation for P/A,

$$\frac{P}{A}=\left(\frac{c\pi^2k}{f}+\sqrt{\frac{c^2\pi^4k^2}{f^2}+16\,L^2}\right)\frac{r^2F}{2\,cL^2} \quad \ldots\ldots (12)$$

It is to be noted that for columns with built-in or fixed ends, the length L in Eq. 12 is to be taken between points of inflection of the elastic curve of the column, that is, $L = L/2$. For columns with one end fixed and the other end free, the length is to be taken as 0.7 L. (See "Theory of Elastic Stability" by S. Timoshenko, McGraw Hill Book Co., New York, 1936, p. 89.)

In Table I, a comparison of Eq. 12 with the empirical formula, $17{,}000 - 0.485\,\frac{L^2}{r^2}$ of the American Institute of Steel Construction is given for values of L/r from 95 to 120. Note that, for $P/A = 17{,}000$, that is, for the maximum permissible unit stress adopted by the AISC formula, Eq. 12 holds true for $L/r = 91.75$ as the minimum slenderness ratio applicable to long columns. It is also to be noted that, in order to compare the two formulas, the column length L between points of inflection was assumed as 95 r, 100 r, etc. (corresponding to the values of L/r as given in the AISC Manual, 1952 edition, p. 209). Equation 12 was also simplified by dropping from under its radical sign the term 16 L^2 (relatively very small as compared with the other term under the radical sign $\frac{c^2\pi^4k^2,}{f^2}$ resulting in the shortened formula used in the table:

$$\frac{P}{A}=\frac{F\pi^2kr^2}{fL^2} \quad \ldots\ldots\ldots (13)$$

TABLE I. Equation 12 for P/A is compared with AISC formula

L/r	P/A by Eq. 12, in psi	P/A by AISC formula, in psi
95	15,810	12,620
100	14,280	12,150
105	12,920	11,650
110	11,815	11,130
115	10,880	10,590
120	9,928	10.020

In this the following values (corresponding to those adopted by AISC) were used: $F = 17{,}000$ psi, $E = 29{,}000{,}000$ psi, $k = E/F = 1706$, $f = 2$, and $\pi^2 = 9.87$.

In summary, two main points about Eq. 12 should be stated:

1. This equation is general in its application for long columns, given the modulus of elasticity E, the permissible unit stress F, the factor of safety f, the column length L, the distance c of the extreme fiber, and the radius of gyration r (both with respect to the neutral axis under consideration).
2. As shown in Table I, when compared with the AISC formula, Eq. 12 yields higher values of P/A for L/r up to 115, approximately the same values for L/r between 115 and 120, and lower values for L/r beyond 120, thus substantiating its validity for long columns.

A nuclear device for fast density-compaction evaluation

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Office of Operations, Bureau of Public Roads, U. S. Department of Commerce, Washington, D. C.

A nuclear testing instrument capable of in-place determination of both the density and the moisture content of highway embankments during compaction was recently studied on a federal-aid project. The instrument was developed by Bryant W. Pocock, Director of the Isotopes Section of the Michigan State Highway Department. The study was made to compare the nuclear method with a conventional method as regards production rate of test results, economy, and improvement in quality control. The nuclear test method provided several advantages. The soil structure was not disturbed; the test production rate was increased by a factor of at least 5; and there was a probable increase in the accuracy of the test results. It also appeared that the nuclear instrument would provide a new means of performing density tests on large-size crushed stone or gravel base courses. Other benefits would be monetary savings, expediting of construction, and improved quality control.

Conventional density and moisture tests require the excavation of a small sample and then a determination of the test-hole volume. Loss of any of the sample material or inaccuracies in determining the volume of the test hole introduce errors in the results. Since the nuclear method does not require volume-weight determinations, except for calibration, chance of error is reduced.

Conventional tests also require the weighing of all soil removed from the test hole and its reweighing after the soil has been oven dried. The technician must make many time-consuming computations to obtain the final result.

By contrast, in using the nuclear gage for a surface density and moisture determination, it is only necessary to place the gage on the surface of the ground, read a number from the counter tubes, and relate this count number to a graph or table to obtain the final result for density or moisture. Density is being effectively measured to a depth of 4 in. Moisture is being measured to a depth of 8 in. These depths can be altered by varying the radioactive source intensity.

The nuclear gage employs a radium-D beryllium radioactive source, which radiates gamma and neutron rays into the material to be measured. These rays are partially absorbed and partially reflected. The reflected rays pass through Geiger-Muller counter tubes in the surface gage and then are amplified and transmitted through an electronic circuit. Counts per minute are read directly on the counter gage. Counts per unit of time are related to density and moisture by means of calibration curves.

A conventional test requires skill and experience on the part of the operator for the consistent performance of the basic steps necessary for determining the field density. By the nuclear method, the test procedure is simplified thus reducing the many chances for error that are present when conventional tests are performed manually.

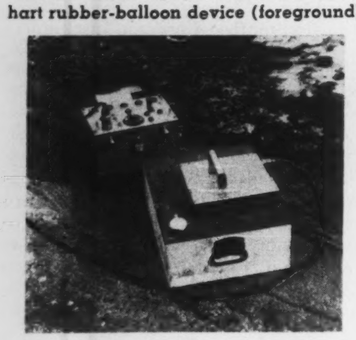
Other possible uses

The nuclear method provides a means of adequately measuring the density of large-size crushed stone or gravel in base courses because the nuclear gage rests on the ground surface and does not require a volume determination, which is impractical for such materials. Similarly, in the case of frozen materials, conventional methods do not provide a means of determining density unless a test pit is excavated.

During the comparative analysis of test production rates, the nuclear method utilized one technician and required four minutes to obtain a final test result for density and moisture. A conventional test was performed in approximately twenty minutes, with the aid of a mobile field laboratory and two technicians. When a portable laboratory is not available, a conventional test can take as long as one hour. Thus the production rate is increased by a factor of at least 5, and potentially by a factor of 15, for tests made by the nuclear method. In effect this results in both a monetary saving and better control of compaction quality. Mr. Pocock is of the opinion that each nuclear gage in use represents a saving of $16,000 a year by the Michigan State Highway Department.

Additional uses of the nuclear method may be developed. Among these is an adaptation to measure the thickness of hardened concrete or bituminous concrete pavements by nondestructive methods. Also, since the gage can measure moisture in percentage or pounds per cubic foot, it is now possible to measure the water content and determine the water-cement ratio of portland cement concrete mixes for quality control. Techniques can also be developed to measure the densities of other materials, such as freshly batched portland cement or bituminous concretes or hardened pavements of either material, stabilized soil-cement courses and structural concrete members. The accuracy of the nuclear moisture and density device should make it a valuable tool in soil identification also.

Comparative in-place density-moisture determinations are made by Michigan nuclear surface gage (rear) and Rainhart rubber-balloon device (foreground).



Safety precautions

Since radiation comes mainly from the front of the nuclear gage, the operator should be careful to keep the gage pointing away from him when it is in use. The safe distance behind the gage for minimum radiation exposure is approximately one foot. Radiation exposure of personnel can be maintained within the Atomic Energy Commission's safety levels if a moderate amount of caution is exercised. Film badges worn by personnel will monitor the amount of radiation exposure. At two-week intervals, these badges are developed by commercial organizations and records kept to determine whether or not the operator is remaining within the safe tolerable limit of exposure recommended by the AEC.

Nuclear gages employing an artificially manufactured radioisotope require the approval and licensing of the AEC. For instrumentation, such as Mr. Pocock's, which employs a naturally occurring isotope of radium, AEC approval and licensing are not required.

A comparison was made of the results obtained by the conventional rubber-balloon density-moisture test (Rainhart method) and the nuclear method. The moisture determinations compared favorably, the average readings of the nuclear method being −0.34 percent less than those obtained by the conventional method. Average densities obtained by the two methods varied only 0.37 percent. However, individual tests showed a greater variation. Comparisons of individual tests are not justified since the test methods are different.

A more reliable evaluation of the accuracy of either method can be obtained by performing, at any given test site, a density test two or more times by the conventional method and then several times by the nuclear method. If possible, each test should be performed by different personnel.

Nuclear testing devices can be further improved by the use of transistors in the electronic counter device, and such use should lead to a decrease in equipment costs. The use of transistors would also increase the portability of the equipment. •

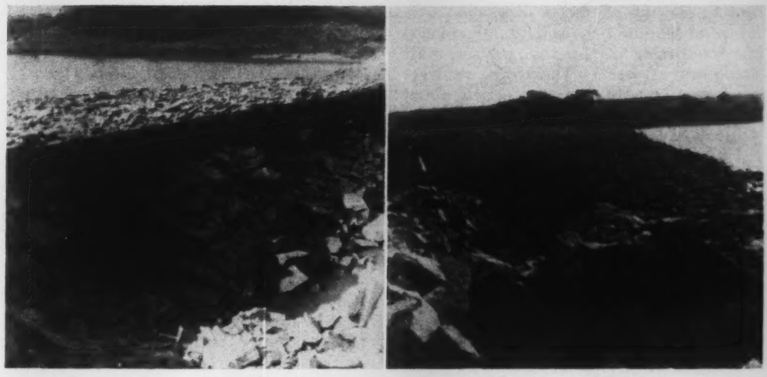
THE READERS WRITE

Partial failure of a loose-rock spillway

To the Editor: Your April 1958 issue (vol. p. 246) carried an article by R. W. Rosene, A.M. ASCE, of Rowat-Murray, and the writer, describing a loose-rock spillway in a low-head dam for the water reservoir of Osceola, Iowa. This loose-rock spillway, evolved to meet the stringent budget requirements of the city and to take advantage of rock available from an adjacent quarry, has partially failed as a result of the severe floods of 1959, combined with shortcomings in its design and construction. It is believed that a report on the performance of this spillway will be of interest to the profession.

In brief, the spillway consisted of a crest maintained by a timber bulkhead, with a deep bed of quarry-run rock placed downstream on a 1 on 5 slope. Below the 1 on 5 slope, a stilling basin was built with a level bed of the same quarry-run rock. The rock was 12 ft deep at the crestline, tapering to 5 ft deep in the stilling basin. The specifications called for quarry-run rock, of which 40 percent or more by weight was to consist of rock 2 ft or more in major dimension. In addition there was a statement of intention that the preponderance of the rock fill would be 2 to 3 ft in size. The specifications also gave instructions as to placement, which were expected to produce an alignment of the flatter rock in a direction more or less perpendicular to the face of the spillway.

Design computations had indicated that the erosive powers of the water would have to be resisted by rock 2½ ft or more in size, and it was believed that quarry-run rock could be obtained in which the matrix of the rock was of the necessary size, and that the smaller rock in the mass would essentially fill the voids. This assumption proved difficult to fulfill in actual construction.



Loose-rock spillway at Osceola, Iowa, was eroded and timber bulkhead at crest deflected during flood of August 6 and 7, 1959.

In the first place, the specification did not produce the expected size of rock, largely because of the way the rock broke up into relatively slender pieces in the quarry blast. Second, the equipment of a contractor who would perform such a small job as this, was incapable of handling rock of the intended size. Third, there was some segregation of the quarry-run rock which tended to produce pockets of smaller rock on the spillway face. Fourth, the intended placement methods appeared impracticable and expensive under the unit-price contract and were not realized.

In May 1959, about a year and a half after its completion, the spillway experienced a moderate flood which produced a head on the crest of about 2.5 ft as compared to the 4-ft head of the design discharge conditions. This flood caused erosion of the spillway face in several places, exposing 4 to 6 ft of the bulkhead wall in two locations. Before repairs were made, another flood of almost equal severity occurred but caused almost no observable change in the scour holes. Temporary repairs were made by filling the scour holes with rock pending a redesign of the spillway face.

On August 6 and 7 a severe flood reproduced almost exactly the design discharge conditions, which were based on a 100-year frequency. The head on the timber crest at the peak of the flow was about 4.0 ft. Erosion on the spillway was quite complete. The timber bulkhead, despite deflection downstream, performed its intended task admirably and retained most of its height, thus preventing loss of the reservoir storage.

This account of the partial failure of the spillway may be of value to those who care to profit by past mistakes. It may be wrong to completely rule out the idea of a loose-rock spillway because of this experience. However, the general conclusion can safely be drawn that construction difficulties make quarry-run material unsatisfactory for use where it is desired to maintain a fairly specific stream-bed configuration. It appears that there must be at least some selection of the rock and control in its placement in lieu of natural selection by flowing water.

Douglas W. Barr, M.ASCE
Consulting Engineer

Minneapolis, Minn.

Editor's Note: *Engineers Murray and Barr voluntarily sent the above information to* Civil Engineering *for publication as a contribution to engineering knowledge. Failures almost always offer a lesson. This information, promptly made available by the engineers, can be used to provide safer structures.*

The engineer in a larger context

To the Editor: "The Civil Engineer in Fiction," by Samuel C. Florman, M.ASCE, in the August issue, vol. p. 544, represents an agreeable variation—and a welcome one—in the fare usually set before the technical reader. But it is doubly welcome in a larger context, in that we see the engineer in an added dimension, stereoscopically as it were. He is preoccupied not merely by his concerns with the business of building, but is related to even larger commitments that have to do with the business of life.

Dean T. R. Agg, M. ASCE, must have had this larger view in mind when he once remarked that the word "engineer" did not derive from the word "engine," nor from the word "ingenuity," as some dictionaries would have it. Its real source was an Old French word which meant "to seek in one's soul a means of accomplishment," and it is this more significant area of contribution that the current author explores in his own way.

Mr. Florman is to be commended for writing so knowledgeably, and not least for his uncommon literacy and command of allusion. Educators deplore the dearth of such proficiencies among engineers generally. If one may cavil in a minor vein, I seem to recall that F. Hopkinson Smith was also a fiction writer of some note, that he was an engineer too (and an Affiliate of ASCE), and that he was the author of at least one work of fiction dealing with lighthouse construction along the southeast Atlantic coast.

Herbert S. Grassman, F. ASCE
Consulting Engineer

Oak Park, Ill.

An answer to President Friel's appeal for UEC

To ASCE Headquarters: The appeal of President Friel in the August issue, "An Open Letter to All Members of ASCE," urging completion of the Society's pledge of $800,000 toward the United Engineering Center campaign, was of sufficient importance to prompt me to ask for a contribution form.

Since I am getting old and am crippled, I never get to the Local Section meetings so had missed this part of the appeal.

Lee M. Bush, F. ASCE
Consulting Engineer

Oklahoma City, Okla.

Editor's Note: *This letter is printed as a reminder to those soliciting funds for the United Engineering Center that personal contacts yield dividends in this campaign.*

New use of welded wire fabric reinforcing

To the Editor: In your July issue appeared an article on "Inverted Concrete Umbrellas for the Roof of a College Library," by Maurice Barron and E. D. Long (vol. p. 482). The article is an excellent presentation of the problems involved, and the solutions reached, in building this unusual structure for Hunter College. It contains, however, several misleading references to the kind of steel reinforcing used for the thin shells owing to a confusion in terminology.

The authors state: "Most of the reinforcing consists of a new type of welded mat made up of large-size bars of cold-drawn steel. These smooth round bars were prefabricated into 10 x 30-ft mats, which were shipped to the site and placed directly in the forms without additional labor, such as for splicing, tying, or bending. For five of the umbrellas, bars of No. 5/0 gage (0.43 in. in diameter) were used, spaced 6 in. on centers."

The confusion lies in the use of the word "bar" instead of "wire" throughout. The reinforcement was, in fact, welded wire fabric sheets, not mats of bars. Bars, of course, are a product of steel rolling mills, while wire is cold-drawn from coiled rod. Because it is cold-drawn, wire has a higher guaranteed yield strength than intermediate-grade bars.

As an industry, we are engaged in promoting the use of sheets of welded wire fabric as opposed to individually placed bar reinforcing (or for that matter, mats made up of bars). Therefore we were concerned to note that your article about an important use of wire fabric might be subject to misinterpretation.

Underscoring our concern is this further statement of the authors: "This is one of the first major uses of bars in mat form in a building." More properly, the statement should read: "This is one of the first major uses of large sheets of large-diameter welded wire fabric in a building."

FRANK B. BROWN
Managing Director,
Wire Reinforcement Inst., Inc.
Washington, D.C.

Canada's vital role in St. Lawrence Seaway

TO THE EDITOR: The first item in "Do You Know That" in the June 1959 issue (p. 43), calls attention to the opening of the St. Lawrence Seaway.

Lake Superior is over 600 ft above sea level. Canada has constructed canals and locks at its own expense for all but 90 ft of this lift.

Canada has dredged the St. Lawrence from Montreal to the ocean for more than fifty years, has built the Lachine Canal, the Beauharnois Canal, the Welland Canal and a canal at Sault Saint Marie, all to date toll free.

Canada and the United States of America built the International Section, about 150 miles long, with a 90-ft rise on a fifty-fifty basis, but not until Canada threatened to go it alone with a side-channel canal or an excavated connection to the Ottawa River.

The U.S.A. Locks at Sault Sainte Marie, 24½ ft on the sills, were built early in the twentieth century and the one on the Canadian side in the latter half of the nineteenth. All the Canadian structures have a depth of 30 ft over the lock sill.

Before the large canal in the International Section was built, Canada built and maintained, toll free, the 14-ft canal through which many small ocean-going freighters passed to U.S.A. ports.

We in Canada would like to see fair recognition given to Canada's part in the St. Lawrence Seaway development.

W. S. PARDOE, F.ASCE
Footes Bay,
Ontario, Canada

Modifications of hammer-blow seismic method

TO THE EDITOR: In the July issue (vol. p. 490), a "new" approach to shallow subsurface exploration by means of hammer blows is described by Messrs. Kallsen and Carlson. It might be of interest to mention that the method of repeated hammer blows on the soil surface, replacing dynamite blasts, has been successfully used since 1949 by the Bureau of Engineering Research of Rutgers University, the state university of New Jersey.

Detailed descriptions have been published in the "Symposium on Dynamic Testing of Soils," A.S.T.M., Special Publication No. 156, 1953, pp. 211-253 and the Highway Research Board *Proceedings*, Vol. 37, 1958, pp. 618-646.

Additional modifications of this method consisted in substituting hammer blows by continuous sinusoidal exciter forces. The advantages are that a standing stable image on a cathode-ray oscilloscope screen is reproducible at any time, in contrast to a hammer blow of short duration only. Furthermore, this steady image permits a direct reading of the phase velocity on the calibrated oscilloscope screen without the necessity of plotting time-distance curves.

R. K. BERNHARD, F.ASCE
Prof., Eng. Mechanics,
Rutgers Univ.
New Brunswick, N. J.

* * *

TO THE EDITOR: The Engineers' Notebook article by Messrs. Kallsen and Carlson, in the July issue (vol. p. 491), gives an excellent description of subsurface exploration with a hammer-seismic apparatus. However, our firm has used an instrument on a similar survey which I believe to be superior to that shown in the article.

The instrument we have used weighs only about 16 lb, excluding the hammer. The time interval can be read directly on indicator lights. Sensitivity can be adjusted to allow work in areas where earth vibrations are of various magnitudes. There is also a built-in blasting circuit for use where the surface material is unconsolidated and the hammer blow fails to provide sufficient energy for reliable results. Primacord is used as the explosive, eliminating the need for fractional sticks of dynamite.

Ellerbe and Company used the instrument on 7.5 miles of Interstate Highway in October of 1957.

WILBUR R. LIEBENOW, A. M.ASCE
Soils Engineer, Ellerbe & Co.
St. Paul, Minn.

Clear-water basin for St. Louis, Mo.

TO THE EDITOR: I have just read with interest the article by Mr. Easterday on the double-walled reservoir construction in St. Louis, Mo. (June issue, vol. p. 404). The unique design and construction concepts used in this reservoir show considerable imagination.

Perhaps the single most significant way to measure the value of a public works improvement is from the standpoint of engineering economy; that is, Is the structure the most economical to serve the given purpose, considering its life, operation and maintenance costs, safety and the time value of the money required?

With this in mind, I was somewhat concerned when I read that this 10-million-gal reservoir cost $1,174,000. A prestressed concrete tank of similar size, considering the present state of technology, has practically an unlimited life and costs about $500,000. A steel water tank, buried or exposed, with full external and internal protection from corrosion, currently costs about $400,000. And last, recent examples of reservoirs constructed with multi-layered asphalt linings and prefabricated wood roofs (with practically indefinite lives except for an expenditure of $15,000 every twenty years for a new roof surface) cost only about $300,000. These approximate costs include normal excavation, site grading and full inlet and outlet control works, including automatic control.

I realize that it is difficult at best to compare costs when one is unfamiliar with local site conditions and other design criteria. But the differences are so great in this case that the variables are perhaps secondary.

With large amounts of bond funds available in many areas and with the large revenue accumulations that many established public utilities have, the real challenge to the public utility engineer today is not how to design a structure that is 200 percent safe, but one that is 100 percent economical.

JEROME B. GILBERT, M.ASCE
Chief Engr. and General Manager
No. Marin County Water Dist.
Novato, Calif.

Author replies

TO THE EDITOR: Mr. Gilbert's expressed doubt that the value of the clear-water basin for St. Louis, Mo., described in my article in the June issue, has ever been measured by engineering economy is interesting. His doubt may be expected since the article did not stress the fact that a positve solution was necessary for functions other than storage. The first cost of a public works improvement is important but other things may be more so. In the case of our clear-water basin, our concern was to design a structure that would meet all the conditions imposed for the lowest cost.

A positive method to prevent contamination either by infiltration of ground water or by the flood waters of the Mississippi River was given a value equal to the difference in cost between the basin as built and that of a conventional underground basin. With us these conditions are a "must."

Moreover the basin had to be built between the present filter plant and a new distribution pumping-station with the ground floor 2 ft above the top of levees and flood walls now being built along the Mississippi River nearby. The water table is 12 to 15 ft above the basin floor and soil conditions are bad.

The capacity of the clear-water basin is stated as 10 million gal, to which can be added another 45 million gal in the purification plant, above the filter plant wash-water gutters, making a total of 55 million gal available through the basin to the new pumping station, with all primary pumps idle.

This relatively small clear-water basin, together with the new pumping station and pressure conduits from here to the distribution system, will replace one 20-million-gal covered clear-water basin and pumping station four miles away, another 60-million-gal covered clear-water basin and pumping station 8 miles away, and 8 miles of gravity-flow conduits, and reduce the present operating cost of the water works not less than $500,000 a year.

We believe that this basin as built is justifiable since it is a permanent link in a chain of other permanent and safe structures.

E. E. Easterday, M.ASCE
Chief Engr., Design & Construction, Water Div., City of St. Louis

St. Louis, Mo.

Protests "fictitious" salaries reported for educators

To the Editor: In the report of the ASCE Committee on Salaries in the August issue (vol. p. 564), fictitious salaries are again used for educators in comparisons with the salaries of engineers in professional practice. The report states:

"Increases for educators range from 6 percent for instructors to 14 percent for professors. Rates for assistant and associate professor show an 11-percent increase—heads of departments, 12 percent. For comparative purposes, salaries paid by educational institutions are adjusted to an eleven-month basis (see Fig. 9). A similar adjustment was made in the 1957 report. No attempt has been made to evaluate educators' supplementary income."

The percentage increase looks large compared to the 6.2 percent increase in professional grade rates, but it must be remembered that educators' salaries have not kept pace with industrial ones, and hence the percentage is applied to a lower base. But the really misleading "adjustment" lies in multiplying salaries by eleven-ninths. This is not take-home pay, and cannot be spent. While educational salaries are admittedly too low, and the engineering societies say they are working for an improvement, why do they "inflate" the salary scale and make it appear much better than it is?

It is a dangerous practice to "adjust" salaries for a number of reasons. Not all professors work two months every summer at their regular pay scale. Some earn more. Many who do work must leave their college town and incur extra living expenses away from home. A few teach summer school, usually at a rate below their regular salary and for only a part of their summer "vacation." While some receive a little extra compensation for sponsored research, the majority have no such opportunity, and work on unsponsored problems in an effort to get something published and so enhance their professional status.

No other group of engineers have had their salaries "adjusted" for vacation time. Moreover, most of the engineering instructors of my acquaintance put in more than 40 hours a week during the academic year. Many are on call Saturdays, teach evening classes, and take work home at night, for which no "adjustment" is made.

Not only is it unfair to "adjust" salaries for statistical purposes, it is also discriminatory to attempt to evaluate educators' supplementary income and not do so for other groups. Educational salaries should be reported as they are, and efforts continued to make them respectable.

S. B. Folk, F. ASCE
Prof. of Eng. Mechanics The Ohio State Univ.

Columbus, Ohio

Editor's Note: *The full salary report appears in the September 1959 "Journal of Professional Practice." Comparative studies of pay rates in all professional categories (Tables VIII and XXIII in the full report) are based on actual salaries paid to educators.*

Salaries reported by educational institutions cover nine-, ten-, eleven-, and twelve-month pay periods. Conversion to eleven-month equivalents (Fig. 9 in the digest and in the full report) provides a common denominator for determining trends at various grade levels.

Reprints of the Salary Survey are available on request to Society headquarters. Ask for Proceedings *Separate No. 2188.*

Better communications

To the Editor: The role of communications in accelerating or hobbling organizational thinking is often overlooked. The larger companies believe that all that is required to keep people informed is a lengthy distribution list and a monthly or semi-monthly meeting of a selected few department heads. The smaller companies rely chiefly on the routing technique and daily contacts among a few top people. But no organization can function effectively without a definite plan for disseminating information to its people on a timely and continuous basis.

In every organization there are many individuals who are holding back bits of information that would assist others in "finalizing" their thinking, and in stopping duplication of effort and useless wheel spinning. Let's check the responsible heads of an organization on two points only:

1. Do all orders and decisions contain an answer to the question, Why?
2. Do the responsible heads speak and write not only to be understood but so that they cannot possibly be misunderstood?

It may be Utopian thinking to believe there can be an organization that functions totally without petty jealousies, where each employee recognizes the strengths of the others and acknowledges his own weaknesses, where each complements the efforts of the others to attain the ultimate in creative and productive effort. But if the communications problem is solved, a long step will be taken in the right direction.

C. A. Budnik, F. ASCE
Asst. Manager, Field Activities, Industrial Construction Div. Kaiser Engineers

Oakland, Calif.

Civil engineers can be proud of their achievements

To the Editor: I was surprised to read such sharp criticism of the civil engineering profession as that presented by Past President Mason G. Lockwood in his article, "Five-Percent Engineering?" in the July issue (vol. p. 465).

Mr. Lockwood's assertion that our profession has failed by lack of creativity cannot be left unchallenged. Never before in the history of mankind have public works been as daring in scope, size and impact as during the 20th century.

It is true that the engineering fee as a function of the construction cost is hardly compatible with the idea of economy. However, Mr. Lockwood's criticism in this respect seems to apply more directly to non-specialized firms which employ "general practitioners" for the design of specialized projects.

In some of its aspects civil engineering is no longer an art. A large part of the public works at present under construction must be standardized so that they can be produced and reproduced on a large scale, and constructed rapidly enough for use while they can still serve their immediate purpose.

The centers of research, creativity and original thinking have traditionally been in agencies such as the Bureau of Reclamation, the Corps of Engineers, the TVA, the Bureau of Public Roads, to name only a few. Research institutes for construction materials have also done their share of original thinking. The numerous and excellent technical papers published by the ASCE are a monumental refutation of Mr. Lockwood's thesis.

As to the assertion that "engineers resist change inordinately," this conservatism is not due to the intrinsic nature of engineers, but rather to their awareness of an incomplete knowledge of the laws of nature, and to their stern concern for safety of life and property.

Mr. Lockwood's remark that "nearly everything civil engineers build is destroyed by obsolescence or change—but not deterioration" is actually a tribute to the profession and its ability to safely harness the forces of nature. Indeed, when properly maintained, civil engineering structures almost always serve the community for a longer period than that for which they were designed.

Surely there is still room for much progress, but in my opinion the civil engineering profession of this country can be proud of its achievements.

Marcel Bitoun, M. ASCE
Hydraulic Engineer

Harrisburg, Pa.

SOCIETY NEWS

President Friel Hails UEC as Unity Force

In an address on professional unity, delivered at a recent meeting of the Akron Section, ASCE President Francis Friel sees the building of the United Engineering Center, for which ground will be broken on October 1, as a very practical step toward unity and the advancement of the profession. Excerpts from President Friel's compelling address follow:

"A great many things are being said in a great many different ways these days, in order to convince a quarter-million technical men that the new Engineering Societies Center has more than local significance enhancing the beauty and status of a limited area of a single city. . . . The effort extended has already contributed practical steps toward unity, one of which is the addition of the American Institute of Chemical Engineers to the body of the four Founder Societies. This single amalgamation of interests is tremendously important to the cause of unity.

"Many engineers interested in the advancement of the profession cannot realize the loss of prestige to themselves and their profession in the eyes of visitors when they come to the present Engineering Societies Building. Office facilities, meeting room facilities, auditorium facilities, elevator facilities, and all the others, inspire many a whimsical side comment about the 'progressiveness' of engineers if their own building is to be taken as an example.

"During my tenure as President of the Society, members of ASCE have been asked to contribute two cents each for every twenty-five cents required to construct the new Center. We have a good start, and it is my urgent hope that the total of $800,000 will be subscribed before I deliver my final report. It would seem to me that every wearer of the Society's royal blue shield, every younger member, and every young student in both the continental United States and the far-flung Sections and Chapters would want to have some measure of investment in this project. When the structure has been completed and is working at its full functional capacity, when it has become the pride of the world's technical men, contributing to the status and honor of the profession, then it would seem to me that the Society member who denied himself the privilege of contributing to the limit of his reasonable capacity will have cause for regret. Stated more positively, each contributor will have cause for self-congratulation in the feeling that he has advanced the cause of unity to the extent of his reasonable resources by at least one concrete act.

"Members of ASCE have now pledged almost $570,000 from approximately 9,800 subscribers, for an average of $58 per subscriber. This is 71 percent of our goal. If the 33,200 members of the Society who are non-subscribers to the building fund would each contribute one year's dues, we would go over the top to the extent of half a million dollars. It is just as simple as that!"

UEC HONOR ROLL

For two months the UEC Honor Roll has kept the status quo with no additions to the list (published in September) of the twenty Local Sections, which have met their quotas in the drive for funds for the new United Engineering Center. On the bright side, fifteen Sections are above 70 percent of their quotas, and eleven are each within $1,000 of theirs. In the meantime, we list again the successful twenty in the order of going over the top. The figures at the right show percentages attained on September 4.

Kentucky (109)
Lehigh Valley (132)
Nashville (103)
Cincinnati (141)
Columbia (127)
Philadelphia (128)
Hawaii (119)
Rochester (123)
Ithaca (114)
Southern Idaho (144)
Indiana (134)
Delaware (105)
Kansas Cty (109)
Central Pennsylvania (106)
Arizona (108)
West Virginia (120)
Central Ohio (103)
Tri-City (105)
Puerto Rico (106)
Wisconsin (102)

Last minute flash—As we go to press, the Georgia Section makes it.

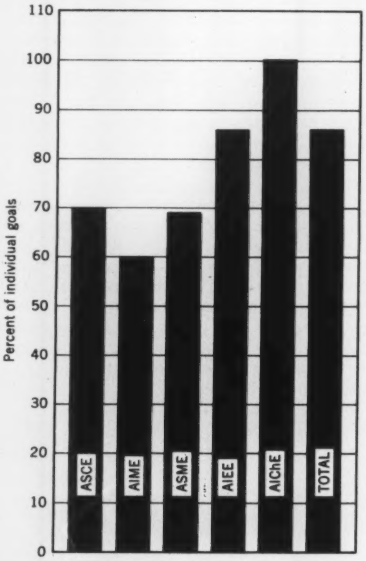
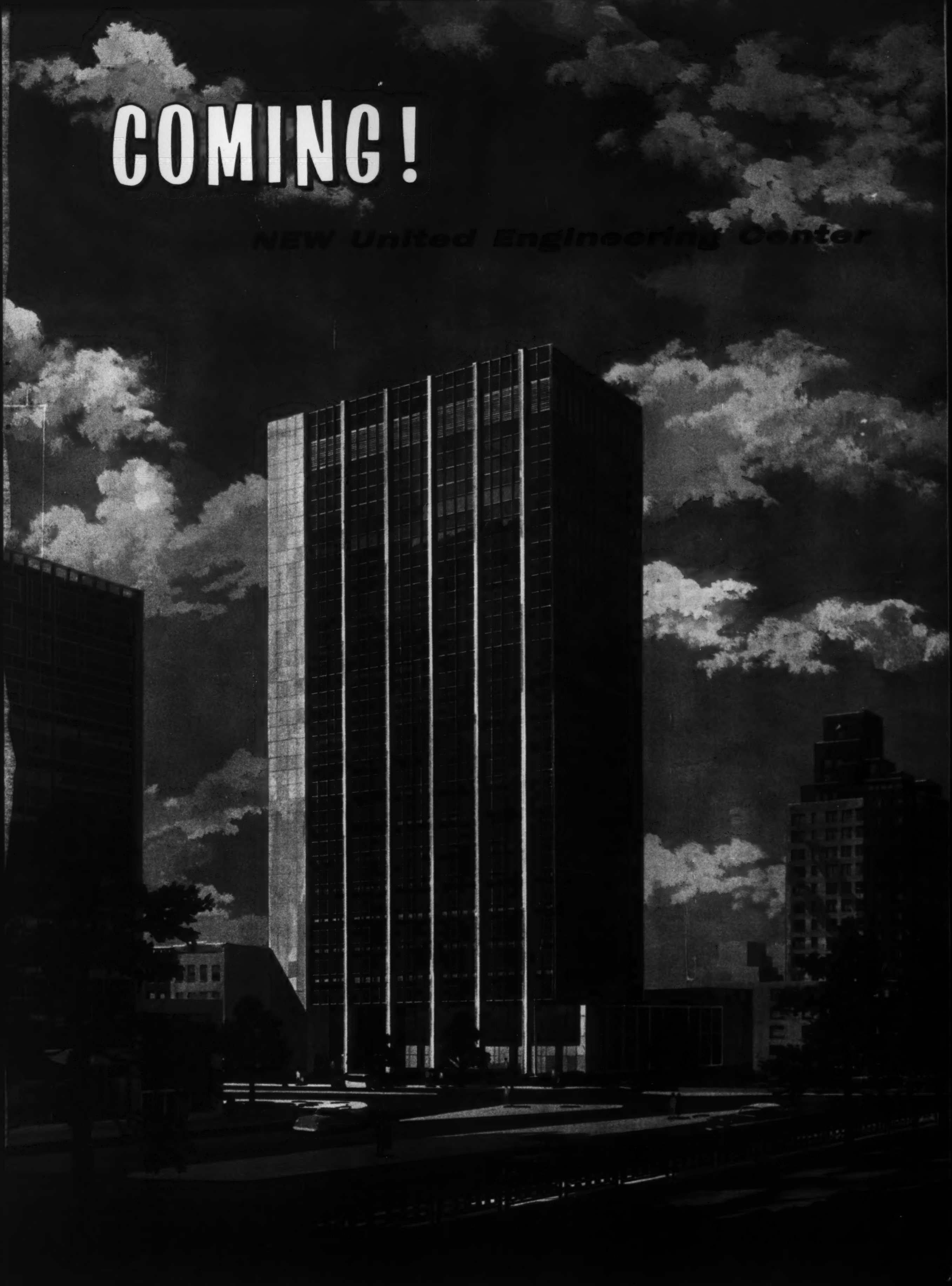


Fig. 1. Member giving for United Engineering Center as of September 11.

(Results of the campaign in ASCE Sections are shown on page 77.)

Pledge cards for contributing to the UEC fund may be obtained from the secretary or fund chairman of your Local Section or Branch, or by postcard request to ASCE, 33 West 39th Street, New York 18, N. Y.


COMING!
NEW United Engineering Center

UEC BUILDING FACTS — 18 stories high . . . 263,067 sq ft, gross, and 179,885 sq ft, net, almost twice as much net space as in the present 39th Street building . . . auditorium to seat 450 people . . . the world's most complete engineering library . . . the Engineering Index, the most comprehensive indexing and abstracting service for engineers . . . central services to avoid duplication of costs . . . Architects: Shreve, Lamb & Harmon Associates . . . Structural engineers: Seeyle, Stevenson, Value & Knecht . . . Mechanical and electrical engineers: Jaros, Baum & Bolles . . . Contractor: Turner Construction Company.

NEW

UNITED ENGINEERING CENTER

COMING! And indeed it is coming — the new United Engineering Center, the beautiful building as shown, in color, on the reverse side.

Commencement of construction in early fall, 1959 . . . Completion of construction by March, 1961 . . . Ready for occupancy by July, 1961 . . . these are the target dates for the new building.

The New United Engineering Center will rise and stand as a monument to a proud and noble profession. Just as its near neighbor, the United Nations on United Nations Plaza in New York City, stands as a symbol of world co-operation, the new United Engineering Center will stand as a symbol of engineering unity and co-operation in the United States. It will be the greatest center for engineering interests in the world. It will be a structure in which every engineer will have justifiable pride.

There is no question that the building will be built. But the drive for funds cannot be allowed to slow down. This message reaches you at a time when we have just passed the three-quarter mark in our fund campaign. The home stretch — and victory in this united drive — lie in the weeks ahead.

Now is the time for all campaign workers to make sure that all members of each section have at least been contacted. It is the time for all sections of all societies to strive for 100 per cent completion of their quotas. It is the time for those sections which already have reached their money goals to keep trying for 100 per cent membership contributions.

And it is also the time for those engineers who already have contributed to ask themselves: "Have I done my part? Have I given to the best of my ability?"

THE FUTURE HOME OF THESE ENGINEERING ORGANIZATIONS

American Society of Civil Engineers
American Institute of Mining, Metallurgical and Petroleum Engineers
The American Society of Mechanical Engineers
American Institute of Electrical Engineers
American Institute of Chemical Engineers
American Institute of Consulting Engineers
American Institute of Industrial Engineers
American Society of Heating Refrigerating and Air-Conditioning Engineers
American Welding Society
Illuminating Engineering Society
Society of Women Engineers
Engineering Index, Inc.
Engineers' Council for Professional Development
Engineers Joint Council
United Engineering Trustees, Inc.
Welding Research Council

Nine New Officers to Be Installed During Convention

Highlights in the Careers of New ASCE Officers

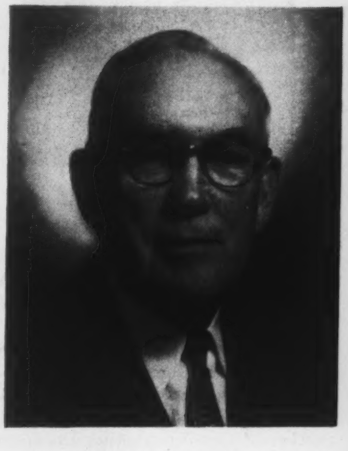
Frank A. Marston

Frank A. Marston, who will take office in October as 91st President of the Society, is a former Director and Vice-President and widely known as a consulting engineer specializing in sanitary engineering work and in soil mechanics and foundation problems. For 37 years a partner in the Boston civil engineering firm of Metcalf & Eddy, he has been engaged on engineering projects all over the country, including water and sewerage works, refuse disposal plants, and drainage investigations. He went to work for Metcalf & Eddy in 1907, following his graduation from Worcester Polytechnic Institute.

Since 1937 Mr. Marston has been consulting sanitary engineer on the staff of the chief engineer of the New York City Board of Water Supply, and since 1943 a member of the Interdepartmental Board for the Sanitary Control and Protection of the Public Water Supply of that city. Major projects with which he has been connected include a sewage-treatment plant, large diversion sewers, and investigation and report on a sewerage system, all for the District of Columbia; sewers and a sewage treatment plant for Louisville, Ky.; and reconstruction of water pumping stations and a new mechanical water-filter plant for Wilmington, Del. His many other projects in the sanitary engineering and soil mechanics fields include expert testimony in a number of Court cases and service on boards of arbitration.

Mr. Marston first joined ASCE as a Junior Member in 1910 and has been a Member since 1920. His multiple assignments on the committee work of the Society include the Committee on Engineers' Code; the Committee on Professional Fees (chairman for a year); the Executive Committee of the Soil Mechanics and Foundations Division (chairman for four years); and the Task Committee on Technical Division Structures. While Director of the Society from District 2 (1952-1954), he served on the Committee on Publications, the Committee on Professional Conduct, and the Committee on the Budget. He was Vice-President of the Society for Zone I in 1956 and 1957.

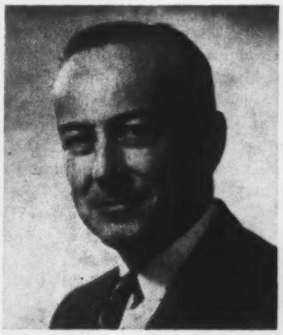
A life member of the Boston Society of Civil Engineers, Mr. Marston has served as its president. He is also a life member of the New England Water Works Association, the American Water Works Association, and the American Public Works Association. He is a member of the Massachusetts Society of Professional Engineers, the National Society of Professional Engineers, the New England Sewage and Industrial Wastes Association, and the American Society for Testing Materials.



FRANK A. MARSTON
President-Elect of ASCE

Charles B. Molineaux

The new ASCE Vice-President for Zone I is Charles B. Molineaux, a construction expert and vice-president of the Arthur A. Johnson Corporation, heavy construction contractors of New York City. Mr. Molineaux is a civil engineering graduate of Brooklyn Polytechnic Institute, class of 1924, and has taken graduate degrees at St. John's University and New York University. His early activities were with New York City utility and transportation companies on plant construction.



CHARLES B. MOLINEAUX
Vice-President, Zone I

Since 1925 Mr. Molineaux has been with the Arthur A. Johnson Corporation, successively as engineer, chief engineer, and vice-president on a wide variety of construction work in the Northeastern States and Canada. He was chief engineer on the construction of the Quabbin Dike for the Boston water supply system and project manager on construction of the Toronto subway, the first rapid transit system in Canada. He has also collaborated with other engineers and contractors on joint ventures, and in this capacity has been associated with the Mason & Hanger Co., Inc., B. Perini & Sons, Inc., Peter Kiewit Sons Company, MacLean-Grove & Co., Inc., and others.

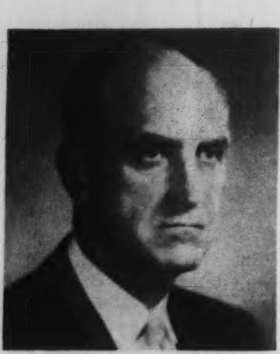
Mr. Molineaux has presented papers at several ASCE Conventions and is the author of several CIVIL ENGINEERING articles. Becoming an Associate Member of the Society in 1928 and Member in 1937, he served as Director from 1952 to 1955. He has represented ASCE at several international conferences, and has been president of the Metropolitan Section.

Mr. Molineaux is a trustee and treasurer of United Engineering Trustees, a member of the Engineering Societies Library board, a member of the Engineering Foundation board, and trustee of the Moles. Recently he was honored by the Polytechnic Institute of Brooklyn with its Public Service Award.

Lawrence A. Elsener

Lawrence A. Elsener, newly elected Vice-President for Zone IV, has been prominently identified with the Chicago Bridge & Iron Company since 1922. He has been in the Chicago district contracting office, contracting engineer in the San Francisco office, district sales manager in San Francisco, and since 1952 vice-president for the company's western area, with headquarters in San Francisco. He is a native of Indiana and a civil engineering graduate of Purdue University.

Becoming an Associate Member of the Society in 1927 and a Member in 1942, Mr. Elsener was Director for District 11 from 1955 to 1957. He has served on many Society committees, including Pro-



LAWRENCE A. ELSENER
Vice-President, Zone IV

ELMER K. TIMBY
Director, District 1

SAMUEL S. BAXTER
Director, District 4

fessional Conduct, Conditions of Practice, Employment Conditions, Economic Advancement Objectives, and Establishment of Local EJC Groups, and has been Board contact member for the Pipeline Division. He is currently chairman of the Task Committee on Administrative Procedure. Locally Mr. Elsener has been active in San Francisco Section affairs, serving as president in 1948. He was general chairman of the ASCE Convention held in San Francisco in 1953.

Mr. Elsener's other professional affiliations include the American Petroleum Institute and the American Water Works Association and the honorary societies, Sigma Xi and Chi Epsilon. He also belongs to the Engineers Club of San Francisco and was president in 1942.

Elmer K. Timby

The new ASCE Director for District 1 is Elmer K. Timby, widely known as an engineering educator and consulting engineer. As partner since January 1950 in the New York City office of the consulting firm of Howard, Needles, Tammen & Bergendoff, Mr. Timby has been associated with the planning, design, and construction of a number of important highway, airport, and bridge projects.

Mr. Timby is a 1928 graduate of Ohio State University, where he was awarded the B.C.E. degree. In 1933 he received the C.E. degree there. He also completed summer school graduate courses at Carnegie Institute of Technology and the University of Michigan. From 1928 to 1941, Mr. Timby was on the Princeton University civil engineering faculty, where he was promoted through the various teaching grades to associate professor. In 1946 he returned to Princeton, remaining until 1949 as professor and chairman of the civil engineering department.

During his leave of absence from Princeton, Mr. Timby was for two years employed as a principal associate engineer with Howard, Needles, Tammen & Bergendoff. From 1943 until early 1946 he was in the Civil Engineer Corps of the U.S. Naval Reserve, advancing from lieutenant to lieutenant commander. One of his principal assignments during this period was as head of the Design Control Section of the Construction Department of the Bureau of Yards and Docks. He was also a member of a special inter-service board to investigate the effects of strategic bombing.

Mr. Timby has served ASCE in many and varied capacities. He has been chairman of the Subcommittee on Publication Policy of the Committee on Applied Mechanics; secretary and chairman of the Executive Committee of the Construction Division; chairman of the Committee on Research; and chairman of the Committee on Engineering Education's Subcommittee on Study-in-Employment. He is currently vice-chairman of the Executive Committee of the Structural Division. He has also served on the Alfred Noble Prize Committee; the Committee on Military Affairs; and on task committees of the Highway and Structural Divisions. Mr. Timby has also served on several Metropolitan Section committees and was on the Annual Convention Committee for four years.

Mr. Timby has represented the Society on the Engineering Foundation board; on the Committee on Engineering Sciences of Engineers Joint Council and the EJC Committee on Nuclear Engineering and Science; and on the Engineers Council for Professional Development. For a number of years he was on the executive committee of the Column Research Council.

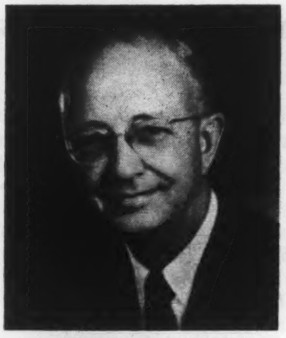
Samuel S. Baxter

Samuel S. Baxter, Director-elect for District 4, has had an impressive career in Philadelphia municipal service. He has been water commissioner since 1952, and chief engineer of the Water Department since 1956. From 1923 to 1942 Mr. Baxter was in the Department of Public Works, for the latter two years of this period as assistant director of public works. He then saw four years of wartime service in the Army Corps of Engineers, rising from second lieutenant to major. His army service included three years on the "Manhattan" atom bomb project at Oak Ridge. From 1946 to 1950 he was assistant chief engineer in the Philadelphia Bureau of Engineering, and from 1950 to 1952 chief engineer of the Bureau.

Mr. Baxter's work as water commissioner and chief engineer has included the construction and operation of three large new sewage treatment plants for the city. The cost of these projects, with their intercepting sewers and appurtenances, has been over $80,000,000. Work in progress, under his direction, includes the construction of three new filter plants. One of these, the Torresdale plant, has a capacity of 423 mgd.

Active in the American Public Works Association, Mr. Baxter served as national president in 1947 and he is currently vice-chairman of its Research Foundation. He also holds the association's Greeley Service Award and the Meritorious Service Award of the Philadelphia Chapter. Other honors that have been awarded Mr. Baxter include the Mary S. Irick Drexel Medal from his alma mater, the Drexel Institute of Technology. He was also cited as 1959 Engineer of the Year by the Philadelphia Chapter of the Pennsylvania Society of Professional Engineers, in which he has been active. Mr. Baxter has been president of the Philadelphia Chapter of the American Society for Public Administration, and he is currently serving as national director of the American Water Works Association.

Long active in the Philadelphia Section of ASCE, Mr. Baxter served it as president in 1951. He joined the Society as a Junior Member in 1926, becoming an Associate Member in 1935 and Member in 1946.



THOMAS M. NILES
Director, District 8

TRENT R. DAMES
Director, District 11

WOODROW W. BAKER
Director, District 14

Thomas M. Niles

The Director-elect for District 8 is Thomas M. Niles, a partner in the Chicago civil engineering firm of Greeley and Hansen. A 1923 graduate of the University of Wisconsin, Mr. Niles was an instructor in hydraulic and sanitary engineering there for two years following his graduation. In 1925 he entered the employ of Greeley and Hansen, and he has been a partner since 1940.

During his long tenure with the firm Mr. Niles has performed and directed the engineering services for many water supply, sewerage, and sewage treatment projects in various parts of the country. Among the prominent projects he has designed are the intercepting sewer system for the Buffalo Sewer Authority; the Washington, D. C., water pumping station; and sewage disposal projects for Alexandria and Richmond, Va. He was also supervising engineer on the construction of Camp Forrest in Tennessee.

A member of ASCE since 1939, Mr. Niles has served on the Society's Committee on Water Supply, the Joint Committee on Rates and Rate Structures (as co-secretary), the Washington Award Commission, and the Committee on Prizes (as chairman). Long active in the Illinois Section, he has been director, vice-president, and president.

His other professional affiliations include the American Institute of Consulting Engineers, the American Water Works Association, the Federation of Sewage and Industrial Wastes Associations, and the Western Society of Engineers (trustee).

Trent R. Dames

The Director-elect for District 11 is Trent R. Dames, senior partner in the Los Angeles firm of Dames & Moore. Mr. Dames' entire professional career has been in the field of soil mechanics. In 1938, after early experience with consulting firms and with the Bureau of Reclamation, he and William Moore founded the firm of Dames & Moore, which has become widely known in the soil mechanics field.

Joining the Society in 1934, Mr. Dames became an Associate Member in 1941 and a Member in 1947. His many contributions to ASCE include the chairmanship of the Task Committee on Technical Sessions in 1952 and 1953 and of the Committee on Junior Members in 1957. He is currently vice-chairman of the Committee on Publications of the Department of Conditions of Practice, and is ASCE representative on the Professional Training Committee of the Engineers' Council for Professional Development.

Long active in the Los Angeles Section, he has been secretary, vice-president, and president. During his term as president (1953), four Branches and three Technical Groups of the Section were formed. From 1955 to 1958 he was chairman of a committee of past officers of the Section, which reorganized the structure and administration of the Section and compiled a Manual of Policy and Procedure to guide its activities. He was an early president of the Los Angeles Junior Forum and has been chairman of a number of Section committees. He was technical program chairman of the Society's 1950 Los Angeles Convention and general chairman of the 1959 Los Angeles Convention.

Mr. Dames' other affiliations include the American Institute of Consulting Engineers, the Seismological Society of America, and the Structural Engineers Association of Southern California.

Woodrow W. Baker

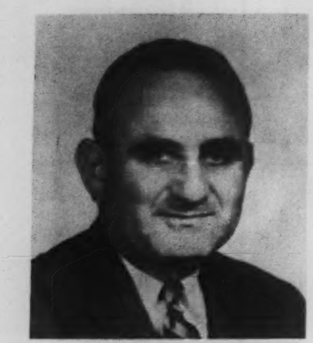
Woodrow W. Baker, city engineer of Oklahoma City, Okla., and the new Director for District 14, has had a versatile career, combining Army and Navy Service, engineering and science teaching, and municipal service.

Mr. Baker is a graduate of Oklahoma State University, with a master's degree in civil engineering. He was in the Army Corps of Engineers at Nashville, Tenn., in 1941 and 1942 and again in 1947. In World War II he saw four years of service in the Navy Civil Engineer Corps —for part of the time in the Pacific Theater. In the 1946-1947 academic year he taught science and engineering at Arkansas Polytechnic College, and from 1948 to 1950 he was instructor in civil engineering at Oklahoma State University. Since 1951 he has been coordinating engineer and city engineer of Oklahoma City.

Becoming a Junior Member of ASCE in 1941 and Associate Member in 1952, Mr. Baker has done considerable Society work, especially in encouraging civil engineering student attendance at ASCE Conventions. At present he is contact member for the Oklahoma State University Student Chapter. Long active in the Oklahoma Section, he was chairman of the Section's Oklahoma City Branch in 1953-1954 and president of the Section in 1955-1956.

Among his other affiliations are the National Society of Professional Engineers, the American Public Works Association, and the national honor societies, Chi Epsilon and Sigma Xi.

ASCE Has Five New Honorary Members



BERNHARD DORNBLATT
Director, District 15

Bernhard Dornblatt

Bernhard Dornblatt, president of the New Orleans firm of B. M. Dornblatt and Associates, Inc., will represent District 15 on the Board of Direction. A 1924 graduate of the University of Georgia, Mr. Dornblatt received an M.S. in C. E. from Georgia Institute of Technology in 1934, and graduated from the Army Engineer School and Command and General Staff School in 1945.

After early work with the South Carolina State Highway Department and the State Highway Board of Georgia, Mr. Dornblatt was with the Portland Cement Association (from 1936 to 1941) as structural engineer and senior engineer for the State of Louisiana. In the Army Corps of Engineers from 1941 to 1946, Mr. Dornblatt rose from the rank of captain to lieutenant colonel. His army service included the construction of heavy bomber bases for the U.S. Air Force in the United States and Canada and service in the Philippines and with the Occupation Forces in Japan. In 1946 Mr. Dornblatt became president and member of the firm bearing his name.

Mr. Dornblatt joined ASCE as a Junior Member in 1930, becoming an Associate Member in 1935 and Member in 1947. He was president of the Louisiana Section in 1950. He has been president of the Gulf Institute of Consulting Engineers; president of the Louisiana Post of the Society of American Military Engineers; vice-president and treasurer of the Consulting Engineers Council; and is currently a director of the Louisiana Institute of Civil Engineers. Among his other affiliations are the American Institute of Consulting Engineers, the American Concrete Institute, the American Railway Engineering Association, the American Road Builders Association, and the American Water Works Association.

His many civic activities include membership on the New Orleans City Planning Commission. He was also director of technical services for New Orleans Civil Defense from 1950 to 1957.

Herbert A. R. Austin

Herbert A. R. Austin, new Honorary Member of the Society and consulting engineer of Honolulu, Hawaii, has devoted his career to the engineering and civic betterment of the Islands.

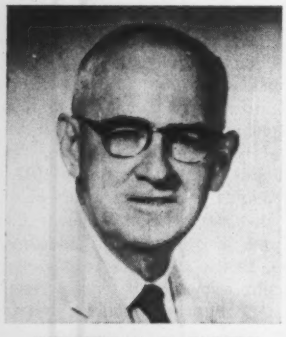
A native of Hawaii, Mr. Austin received his early education there. He then attended Cornell University, where he received his civil engineering degree in 1913. Returning to the Islands, he was in the Water Resources Branch of the U.S. Geological Survey as field engineer for work on five of the Islands. He then saw service as a lieutenant in the Corps of Engineers in World War I. Mr. Austin became the first chief engineer of the City and County of Honolulu Public Works Department when it was formed in 1927. In 1931 and 1932 he served another two-year term in this capacity. He was also valuation engineer for the Territorial Public Utilities Commission, and has been a member of the Honolulu Board of Water Supply and the City Planning Commission.

In private practice since 1934, Mr. Austin has made studies and reports on a wide range of Hawaiian projects. With Roswell Towill, civil engineer and surveyor, he formed a joint venture for handling large civil engineering projects in 1942. Among the important projects, for which he has been in direct charge of design, are 20 miles of trunk sewers for the City of Honolulu; a $30 million residential subdivision and shopping center; several large city and county improvement districts; a water tunnel on Kauai; a jet fuel pipeline and pump facilities for the Naval Air Station at Barbers Point; Air Force facilities on Wake Island; and water supply projects for both Maui County and the City and County of Honolulu. At present he is the consulting and design engineer on the first increment of the Board of Water Supply's $11 million Ewa-Waianae Project. He also designed a five-mile water tunnel for the Hawaii Water Authority, which is currently being built on the island of Molokai. In fact, the growth of both Honolulu and its adjacent areas is attributed in part to Mr. Austin's achievement in designing economical and adequate water supplies for both urban and suburban areas.

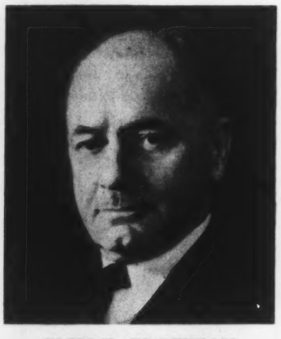
Mr. Austin spearheaded the organization of the Hawaii Section and became its first president in 1938. He was likewise instrumental in founding the Student Chapter at the University of Hawaii, where at one time he taught municipal engineering. He was also the key person in obtaining the accreditation of the College of Engineering at the university. A life member of ASCE, he has been chairman of its committees on Engineering Education, Registration, and Professional Conduct. His other professional affiliations include the Engineering Association of Hawaii, which he served as president in 1945 and 1946.

Glen E. Edgerton

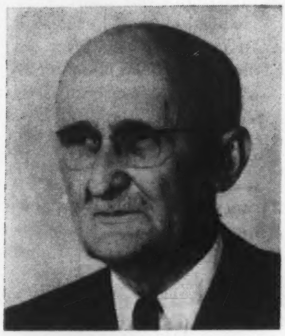
Newly elected Honorary Member Glen E. Edgerton, a consulting engineer and retired Army officer, has to his credit a long record of distinguished service to the profession and to the nation. At the time of his retirement from active service in the Corps of Engineers in 1945, General Edgerton had filled such assignments as chief of the



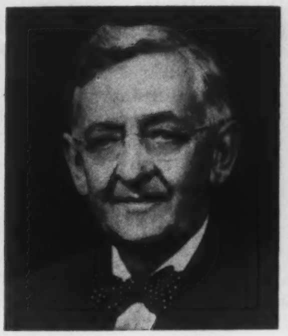
HERBERT A. R. AUSTIN
Hon. M. ASCE



GLEN E. EDGERTON
Hon. M. ASCE



JULIAN HINDS
Hon. M. ASCE



FRANK M. MASTERS
Hon. M. ASCE

GUSTAV J. REQUARDT
Hon. M. ASCE

Rivers and Harbors Section in the Office of the Chief of Engineers; maintenance engineer for the Panama Canal; United States representative on the Joint Highway Board for the Isthmian Highway; governor of the Panama Canal (for a four-year term); director of materiel, Headquarters Army Service Force; associate administrator, War Assets Administration; director of United States Relief and Rehabilitation in in Shanghai, China; and president and resident member of the Beach Erosion Board.

A graduate of Kansas State College (1904) and of the U.S. Military Academy (1908), he served in his early career on road work in Alaska; as district engineer at Jacksonville, Fla., and Rock Island, Ill.; as assistant professor of civil and military engineering at West Point; as lighthouse superintendent for the 13th Lighthouse District; and as assistant to and, later, chief engineer of the Federal Power Commission.

In July 1949 General Edgerton was engaged as executive director of the Commission on Renovation of the Executive Mansion and served in that capacity during the reconstruction of the White House, 1949-1952. From April 1953 to October 1955 he was chairman of the board and president of the Export-Import Bank of Washington. He has also been on the consulting committee of the Suez Canal Company and a member of the board of directors of the Panama Canal Company. General Edgerton's consulting practice has brought him into many phases of national and international engineering. One of his important engagements as a consultant has been an examination and review of a proposed flood control, hydroelectric, and irrigation development on the Tigris-Euphrates.

General Edgerton has been active in ASCE affairs in the various Local Sections where he was assigned in his 41 years of active military service in the Corps of Engineers. He has also been active in the Waterways Division and was its chairman in 1950. He is a frequent contributor to Society publications. One of General Edgerton's major contribution to ASCE has been his personal effort to increase membership from officers and civilian personnel in the Corps of Engineers. This contribution was particularly important some years ago when the proportion of Corps of Engineers officers in the Society was deplorably small.

General Edgerton's military decorations are the Distinguished Service Medal with Oak Leaf Cluster and the Legion of Merit. He also holds the Order of the British Empire, the French Legion of Honor, and many other foreign decorations.

Julian Hinds

Julian Hinds, consulting engineer of Santa Paula, Calif., and a new Honorary Member of ASCE, is famous throughout the West for his achievements in irrigation, reclamation, and water supply work—particularly the development of Southern California's Colorado River supply.

Mr. Hinds was an engineering instructor at the University of Texas from 1906 to 1909 while working there for his B.S. degree in civil engineering. His early experience was as bridge designer for the Chicago, Milwaukee and St. Paul Railway, with headquarters in Chicago, and as concrete inspector for the Gulf, Texas and Western Railway in Texas. From 1910 to 1926 Mr. Hinds was with the U.S. Bureau of Reclamation (then the Reclamation Service) on irrigation design at Sunnyside, Wash., Elephant Butte Dam, N. M., and Denver, Colo. For nine years of this period he was chief draftsman in responsible charge of all design projects. From 1926 until 1929 he was project engineer for the J. G. White Engineering Corp on the Calles and Rio Condos projects in Mexico.

From 1929 until 1952 when he entered consulting practice, Mr. Hinds was associated with the Los Angeles and Southern California water supply, serving as engineer of hydraulic design for the Los Angeles Department of Water and Power; chief design engineer for the Metropolitan Water District (on Colorado Aqueduct investigations); and assistant chief engineer of the Metropolitan Water District of Southern California. From August 1941 to January 1952 he was general manager and chief engineer of the Water District. During this period the District grew from thirteen member cities in a 600-sq mile area to 44 member cities in an area of over 1,500 sq miles. Famous projects designed by Mr. Hinds included the Colorado Aqueduct, chosen by ASCE as one of the "Seven Modern Civil Engineering Wonders of the United States."

Long a member of the Society, Mr. Hinds was Director for District 11 from 1948 to 1950. He has also been vice-president and president of the Los Angeles Section. Author of numerous technical articles on hydraulic design features, he received the Norman Medal in 1926 for a Transactions paper. Subjects on which he has written include the Hydraulic Jump and Critical Velocities, Side Channel Spillways, Arch Dam Analysis, and Stresses in Gravity Dams.

Frank M. Masters

New Honorary Member Frank M. M. Masters is widely known as a consulting engineer and as a builder of some of the country's most notable bridges. He is senior partner in the consulting firm Modjeski and Masters, which has its main office in Harrisburg, Pa., and other offices in Philadelphia and New Orleans.

From 1904 to 1916 Mr. Masters was employed by the late Ralph Modjeski, M. ASCE, on bridge design and construction. After two years of service in World War I as a major in the Ordnance Department of the U.S. Army, he entered private practice as a consulting engineer on special industrial and railway work. From 1924 to 1936 he was a partner of Mr. Modjeski and chief engineer on the construction of a number of bridges and other important structures. In 1937 Mr. Masters became sole owner of the firm, and since 1947 he has been senior partner.

Among the famous bridges constructed during his long association with the firm are the Huey Long Bridge, the Greater New Orleans Bridge, and the Davenport, Iowa, bridge, over the Mississippi; two famous Ohio River bridges; three Susquehanna River bridges at Harrisburg; the Pecos River (Texas) span, the highest railway bridge in the world; and the Calvert Street Bridge in Washington, D. C. In association with Ammann & Whitney of New York, the firm also designed the Walt Whitman Bridge over the Delaware at Philadelphia.

Mr. Masters has made numerous investigations, studies, and reports on the design of heavy foundations, docks, buildings, and wharves. He has also had an important part in investigations of the aerodynamic stability of long-span suspension bridges conducted by a committee of the U.S. Bureau of Public Roads.

Mr. Masters was educated at Cornell University and has an honorary engineering doctorate from Lehigh University. His numerous affiliations include the American Society for Testing Materials, the American Railway Engineering Association, the American Concrete Institute, the American Association for the Advancement of Science, the American Institute of Consulting Engineers, the American Welding Society, and the American Society of Metals, of which he is an honorary member. A life member of ASCE, he has been active in the Philadelphia Section and was director in 1951 and 1952. His wide range of civic interests and activities includes the Harrisburg Symphony and the community theatre.

Gustav J. Requardt

Gustav J. Requardt, new Honorary Member of the Society, has made signal contributions to the profession in his work on ASCE Manuals dealing with the private practice of civil engineering and in his efforts to secure a good registration law for his home state. He is a partner in the Baltimore firm of Whitman, Requardt and Associates.

Following graduation from Cornell University in 1909, Mr. Requardt entered the employ of the Baltimore Sewerage Commission, engaged on the construction of the Back River Sewage Treatment Works. He progressed to the office of assistant division engineer in 1915, when he resigned to join ASCE Past-President Ezra B. Whitman in the consulting firm of Norton, Bird and Whitman. In 1925 he was made a partner in the firm of Whitman, Requardt and Smith. Since 1944 the firm has been known as Whitman, Requardt and Associates. In their earlier years Mr. Requardt's firms were nationally known for their sanitation, water supply, and valuation work, and of more recent years they have added highway, bridge, airfield, and industrial building projects and mechanical-electrical services.

Mr. Requardt has had special personal consulting assignments for the State of New Jersey on Delaware River diversion; for the Army Corps of Engineers on flood pumping of the Susquehanna River; for the City of Cleveland on sewer rental rates; for the City of Baltimore as advisory engineer on future water supply and refuse disposal; and for the District of Columbia on sewage treatment.

Mr. Requardt's interest in private practice has led him in the years since 1915 to amass a wealth of information on contracts and fees. These data have been used in developing fee schedules, which have become standard for civil engineers and many other engineering groups. He was a member of ASCE committees on the preparation of Manual No. 29, "Professional Engineering Practice," (published in 1952) and Manual No. 38, "Private Practice of Civil Engineering," (published in 1959). Manual No. 38 furnishes a complete guide, for the layman as well as the engineer, in engaging, compensating, and understanding the scope of all professional services. Mr. Requardt also aided the profession at the time a registration act was being developed for the State of Maryland by directing the form and wording of the act.

Long active in ASCE, Mr. Requardt was a Director from 1941 to 1943. He was a charter member of the Maryland Section at the time of its formation in 1914 and served it as president in 1933. His other technical society affiliations include the American Water Works Association, the American Public Works Association, the Federation of Sewage and Industrial Wastes Associations, and the Society of American Military Engineers.

Award of ASCE Prizes a Convention Feature

In the vanguard of the profession are the engineers who do research and then report the results in the publications of the Society. The award of Society prizes for Transactions papers that are considered especially important is one of the traditional Annual Convention features. This year the presentation ceremonies will take place at the Wednesday morning meeting during the forthcoming Annual Convention in Washington, D. C.

Though most of this year's awards honor papers appearing in Volume 123 (1958) of Transactions, a few are given on the recommendation of the Technical Divisions for contributing to the advancement of the profession. Another exception is the Construction Engineering Prize, which goes to the author of an especially meritorious Civil Engineering article.

Norman Medal

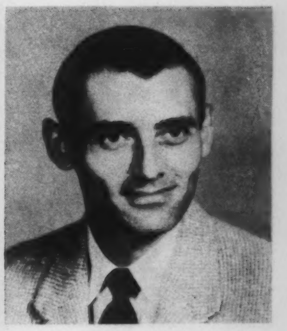
Two authorities in soil mechanics share the Norman Medal, oldest and most coveted of the Society's awards. They are **Willard J. Turnbull** and **Charles R. Foster,** Fellows ASCE, who are being honored for their paper entitled, "Stabilization of Materials by Compaction." **Mr. Turnbull** has been chief of the Soils Division at the U.S. Waterways Experiment Station at Vicksburg, Miss., since 1941. He has represented the Corps of Engineers at a number of international conferences on soil mechanics and foundation engineering, and is one of the U.S. delegation of soil experts visiting Russia this fall. A 1925 graduate of the University of Nebraska, Mr. Turnbull received the honorary degree of doctor of

WILLARD J. TURNBULL

CHARLES R. FOSTER

Co-winners of Norman Medal

CHARLES I. MANSUR



ROBERT I. KAUFMAN

Co-winners of J. James R. Croes Medal

engineering in 1957. His early career included eight years as project engineer and assistant state testing engineer for the Nebraska State Highway Department and six years as soils engineer and chief of laboratory for the Central Nebraska Public Power and Irrigation District. **Mr. Foster,** the co-winner, started with the Corps of Engineers in 1936 and was transferred to the Waterways Experiment Station in 1945. He became chief of the Flexible Pavement Branch in 1950, and assistant chief of the Soils Division in 1958. Since April 1959 he has been coordinator of research for the National Bituminous Concrete Association. Mr. Foster is the author of numerous reports and papers, and was co-author of the paper on flexible pavement design for airfields that was awarded the Thomas Fitch Rowland Prize in 1951.

J. James R. Croes Medal

There were also two collaborators on the paper, "Pile Tests, Low-Sill Structures, Old River, Louisiana," which was awarded the J. James R. Croes Medal, second of the Society's awards in point of distinction. They are **Charles I. Mansur,** F.ASCE, and **Robert I. Kaufman,** M.ASCE, a writing team that received the Thomas Fitch Rowland Prize last year for a paper on Mississippi River levees. **Mr. Mansur** recently joined the Heavy Division of the Fruin-Colnon Contracting Company, St. Louis, Mo. He has had wide experience in the fields of sanitary engineering and soil mechanics and foundation engineering, both as an officer in the U.S. Public Health Service and the Army Corps of Engineers. He has been with the Waterways Experiment Station in a variety of research capacities, and until 1957 was chief of the Geology, Soils, and Materials Branch of the Mississippi River Commission. **Mr. Kaufman** has been in the Waterways Experiment Station since 1949, and chief of the Geology, Soils, and Materials Branch of the Mississippi River Commission since 1957. He is a graduate of Purdue University and has taught civil engineering there.

James Laurie Prize

Two Houston engineers—**Bramlette McClelland** and **John A. Focht, Jr.,** Members ASCE—are winners of the James Laurie Prize, which is named in memory of the first president of the Society. The award honors their paper, "Soil Modulus for Laterally Loaded Piles." **Mr. McClelland** is a 1940 graduate of the University of Arkansas and has an M.S.C.E. degree from Purdue University. He was employed as a research engineer by the Joint Highway Research Project at Purdue from 1940 to 1943, and as a design engineer by the City of Houston from 1943 to 1946. Since the latter year he has been in consulting practice—first as a partner in the firm of Greer & McClelland and, since 1955, as president of McClelland Engineers Inc., soil and foundation consultants of Houston, Tex. **Mr. Focht** has been vice-president and chief of design for McClelland Engineers since 1955, and before that was senior soils engineer for Greer & McClelland. He was in the Soils Division at the Waterways Experiment Station from 1947 to 1953. Mr. Focht is no stranger to Society prizes, having been co-author of the paper receiving the 1957 Thomas A. Middlebrooks Award.

Thomas Fitch Rowland Prize

The paper winning the Thomas Fitch Rowland Prize is another cooperative effort, the joint work of two San Francisco engineers—**J. George Thon,** F.ASCE, and **Gordon L. Coltrin,** M.ASCE. Their subject was "The Morro Bay Steam Electric Plant." **Mr. Thon** is manager of hydro engineering for the Bechtel Corporation, engineers and constructors, with headquarters in San Francisco. He has had wide experience in the fields of hydroelectric, steam, and nuclear power plant design, both in this country and abroad. He has civil engineering degrees from the University of London and the Imperial College of Science and Technology in London. **Mr. Coltrin** started work with the Pacific Gas and Electric

BRAMLETTE McCLELLAND

JOHN A. FOCHT, JR.

Co-winners of James Laurie Prize

J. GEORGE THON

GORDON L. COLTRIN

Co-winners of Thomas Fitch Rowland Prize

FRANK H. NEWNAM, JR.
Arthur M. Wellington Prize

NORMAN H. BROOKS
Collingwood Prize and J. C. Stevens Award

Company in 1945 in the hydroelectric, substation, and transmission design section, and is now responsible for the civil engineering design of substations, transmission, and steam-electric power plants. He is a graduate of the University of California and a veteran of World War II, in which he attained the rank of major.

Arthur M. Wellington Prize

This year's winner of the Arthur M. Wellington Prize is **Frank H. Newnam, Jr.**, F.ASCE, who is honored for his paper on "Developing Port Facilities on Houston's Ship Channel." Since 1946 Mr. Newnam has been a partner in the consulting engineering firm of Lockwood, Andrews, & Newnam, with offices in Houston, Victoria, and Corpus Christi. He directs the general work of the firm. From 1941 to 1946 Mr. Newnam was in the Corps of Engineers in the China Theater of War, rising from the rank of captain to colonel. From 1931 to 1941 he was soils and pavement engineer for the Texas Highway Department. He is the author of numerous publications on the subject of port and harbor development.

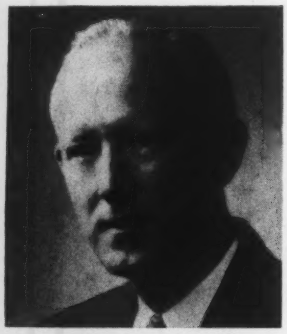
Collingwood Prize for Junior Members

Norman H. Brooks, M.ASCE, associate professor of civil engineering at California Institute of Technology, is winner of the Collingwood Prize for Junior Members (now the Collingwood Prize), for his paper entitled "Mechanics of Streams with Movable Beds of Fine Sand." Professor Brooks has B.S. and M.S. degrees from Harvard University and a Ph.D. in civil engineering and physics from California Institute of Technology. His prize-winning paper was based primarily on his research for his doctorate. During his years at Caltech he has been successively teaching assistant, National Science Foundation Predoctoral Fellow, instructor, assistant professor, and (since 1958) associate professor. He is also consultant on hydraulic problems to the Los Angeles County Sanitation Districts and other organizations.

Rudolph Hering Medal

The paper on "Mechanism of Reaeration in Natural Streams," honored with the Rudolph Hering Medal, is the joint work of two engineering teachers—**Donald J. O'Connor**, M.ASCE, and **William E. Dobbins**, F.ASCE. **Donald O'Connor**, who is associate professor of civil engineering at Manhattan College, has been on the faculty there for the past seven years. He is also consultant on stream and water pollution to the Virginia Water Control Board and to the New York City Department of Health and does stream analysis work for various industries. Co-author **William E. Dobbins** was associate professor of sanitary engineering at New York University from 1950 through 1957, and has been professor of sanitary engineering since 1958. He also conducts an active consulting practice and writes on sanitary engineering subjects.

DONALD J. O'CONNOR



WILLIAM E. DOBBINS

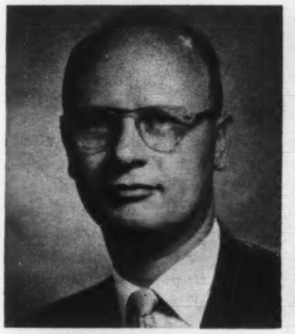
Co-winners of Rudolph Hering Medal

Karl Emil Hilgard Prize

The Karl Emil Hilgard Hydraulic Prize, which is awarded biennially for a superior paper dealing with the problem of flowing water, goes this year to **Emmett M. Laursen**, M.ASCE, associate professor of civil engineering at Michigan State University, for a paper entitled "Sediment-Transport Mechanics in Stable-Channel Design." From 1945 to 1958 Professor Laursen was successively research assistant, research associate, and research engineer at the Iowa Institute of Hydraulic Research in charge of studies of sediment transportation. He is a graduate of the University of Minnesota and received a Ph.D. from the State University of Iowa in 1958.

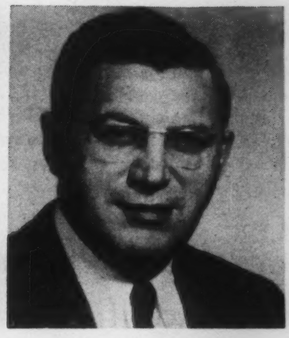
Thomas A. Middlebrooks Award

F. E. Richart, Jr., F.ASCE, professor of civil engineering at the University of Florida, is this year's winner of the Thomas A. Middlebrooks Award for his paper, "Analysis for Sheetpile Retaining Walls." He has been on the University of Florida staff since 1952, and has been a full professor since 1954. For



EMMETT M. LAURSEN
Karl Emil Hilgard Prize

F. E. RICHART, JR.
Thomas Middlebrooks Award



ALFRED L. PARME
Leon S. Moisseiff Award

JAMES P. GROWDON
Rickey Medal

the 1959-1960 academic year Professor Richart has been awarded a Science Faculty Fellowship of the National Science Foundation. He will devote part of the year to special studies in soil mechanics at Harvard, and the other half to the study of harbor structures at the Delft (Holland) Technological University. He holds B.S., M.S., and Ph.D. degrees from the University of Illinois, and was on the Harvard engineering faculty from 1948 to 1952.

Leon S. Moisseiff Award

Alfred L. Parme, M. ASCE, since 1958 manager of the Structural and Railways Bureau of the Portland Cement Association, is the recipient of the Leon S. Moisseiff Award for his paper entitled "Shells of Double Curvature." A 1935 civil engineering graduate of Cornell University, Mr. Parme has been with the Portland Cement Association most of the time since 1940. During World War II he was senior stress analyst for Republic Aviation, and in 1952 he was on leave of absence as consulting engineer for Ebasco Services on the design of Kamishiiba Dam, the first arch dam to be built in Japan. A structural engineering authority, he was awarded the Fuertes Graduate Medal by Cornell University in 1953 for his work on ASCE Manual No. 31, on "Design of Cylindrical Concrete Shell Roofs."

Rickey Medal

This year's winner of the Rickey Medal is **James P. Growdon,** F.ASCE, of Pittsburgh, Pa., who is honored for three papers on the subject of rockfill dams and also "for important contributions over many years to progress in hydroelectric engineering." For much of his career Mr. Growdon was chief hydraulic engineer of the Aluminum Company of America, and he has been consultant to the organization since his retirement from active employment a few years ago. Mr. Growdon's engineering achievements include initiating the use of vibrators for placing concrete; the concept, design, and construction of sloping, flexible earth core rockfill dams; the concept, design, and method of construction of underground oil storage at Pearl Harbor, utilization of structural aluminum in bridges; and the concept, design and construction of erodible fuse plugs for control of spillway discharge.

J. C. Stevens Award

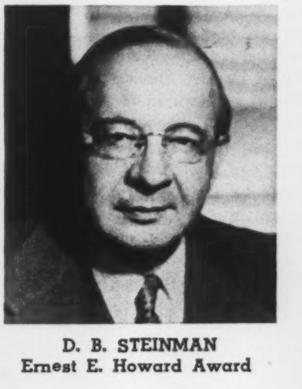
Norman H. Brooks, M.ASCE, winner of the Collingwood Prize for Junior Members, is doubly honored by being winner also of the J. C. Stevens Award for his discussion of his own prize-winning paper, "Mechanics of Streams with Movable Beds of Fine Sand."

Ernest E. Howard Award

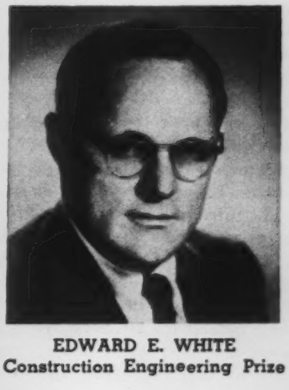
D. B. Steinman, New York City consulting engineer, receives the Ernest E. Howard Award. Known and honored the world over as designer and builder of beautiful bridges, Dr. Steinman is currently cited "for his signal contribution towards the advancement of bridge analysis and design, to the theory of the suspension bridge and its aerodynamic stability, and especially for his outstanding work in the design of the Mackinac Bridge." Among the notable bridges, in addition to the Mackinac Straits Bridge, for which Dr. Steinman was designer or consultant are the Florianapolis Bridge in Brazil; the Mount Hope Bridge in Rhode Island; the Carquinez Straits Bridge in California; the Henry Hudson Bridge in New York; the St. Johns Bridge in Oregon; the Thousand Islands International Bridge; the Baghdad Bridge over the Tigris River in Iraq; the Kingston Bridge across the Hudson; and the Raritan River Bridge in New Jersey. Author of over 750 publications, Dr. Steinman has been awarded four other Society prizes for his papers in Transactions, including the Norman Medal in 1923 and 1951.

Construction Engineering Prize

The Construction Engineering Prize, which is given for an important article in Civil Engineering, goes to **Edward E. White,** F.ASCE, for his article in the November 1958 issue entitled "Deep Foundations in Soft Chicago Clays." Mr. White has spent most of his career with the New York City contracting and en-



D. B. STEINMAN
Ernest E. Howard Award



EDWARD E. WHITE
Construction Engineering Prize

gineering firm of Spencer, White & Prentis, Inc., since 1950 as executive vice-president. His specialty has been the construction of difficult foundations, underpinning, and pile driving. He has been field engineer on the construction of locks and dams on the Mississippi River and project manager on considerable New York City subway construction. During the war he was chief engineer on the construction of a large dry dock built at the Norfolk Navy Yard and of tankers for the Alabama Dry Dock and Shipbuilding Company.

Civil Engineers Face Prospect of Weather Modification

Weather modification is a brand new approach to an old, old problem. It has been but thirteen years since the first cloud-seeding attempts were made. What has been accomplished in this brief period was outlined at a recent conference. This Conference on Weather Modification, held in Denver, August 27-29, was planned by the Irrigation and Drainage Division of ASCE to give civil engineers a chance to appraise the latest information provided by meteorologists. The American Meteorological Society graciously consented to co-sponsor the conference and to furnish most of the speakers. The co-chairmen were Prof. N. A. Christensen, of the Irrigation and Drainage Division, and Dr. Robert D. Elliot, of the American Meteorological Society. All local arrangements were made by a Colorado Section committee, headed by Robert L. Mueller, of Denver.

An Engineer's Hot Potato

As background information, a summation was prepared and presented by Dr. Wallace E. Howell, consulting meteorologist of Lexington, Mass. Dr. Howell reported that the years of experimentation with cloud seeding indicate quite clearly increases in precipitation of from 10 percent to 30 percent, on the ground. However, summer rainfall, as supplemental supply during growing periods, is not as conclusive as the experience with increase in winter snow pack. Both engineers and scientists must work to gain support for the many more practical demonstrations which will prove, with accumulating records, the promise of effective weather modification.

Very appropriately, the conference opened with a paper by Dr. Vincent J. Schaefer. It was Dr. Schaefer who, with Dr. Irving Langmuir, both of General Electric, demonstrated the basic principle of "seeding" clouds, when they dropped dry ice into supercooled clouds over western Massachusetts in November 1946. The range of studies reported by Dr. Schaefer stirred the imagination, ranging from particle sizes in the order of 1/25,000,000 of an inch as compared with weather masses covering hundreds of square miles.

In a recent test over a dry Southwestern state, arroyos were turned into rushing torrents that blocked traffic on a major highway. "Gradually, with the acquisition of scientific knowledge," he reported, "man's hope has been intensified that something might be done about the weather."

A large-scale and continuing project is underway in Arizona. The details of this work, and the promising results were reported by Dr. Louis J. Battan, of the Institute of Atmospheric Physics in the University of Arizona. In these tests, every effort has been made to minimize the nagging uncertainty as to whether clouds would produce rain whether seeded or not. A very careful system of random numbers has been applied to the Arizona tests, to eliminate completely any personal prejudices in the selection of the clouds to be seeded and the procedures to be used. At the halfway point of the tests, records indicate that there has been 30 percent more rain on days that the clouds have been seeded than on days when they have been left alone. On the subject of "stealing" moisture, Dr. Battan commented that the atmosphere is a very inefficient moisture producer, with only about 1 percent of its moisture available for precipitation. Modification can increase this so little, on a percentage basis, that there is no understandable prospect of stealing water from some downwind area.

Another extensive series of tests was reported by Dr. Theodore B. Smith, director of research in meteorology, Pasadena, and Dr. Robin R. Reynolds, of the California Department of Water Resources. This Santa Barbara project is studying the big frontal storms only, because in that area it appears that these are the only appreciable source of water. Several agencies have combined efforts in this major attack upon the evaluation of rain-making procedures. The first three years of the project have not produced a conclusive answer as to the effectiveness of rain making. However, it appeared strongly probable that weather in California had been modified by cloud-seeding operations."

Some Seeding Unintentional

An interesting angle to the study was produced by Dr. Glenn E. Stout, of the Illinois State Water Survey, who reported studies showing that rainfall is becoming heavier in urban areas as compared with sparsely settled areas nearby. While the true pattern of such "urban effects" is still to be determined, several factors may be involved. "Increased turbulence from local heating, greater mechanical mixing of the air, and a greater concentration of condensation nucleae, in addition to increased water vapor from combustion processes, may have been influential in the production of 18 percent more rainfall over the central section of the urban area." While such reports hint at a continuing and unintentional modification of the weather, there is still much work to be done to evaluate such processes.

National Science Foundation Involved

The former chairman of the President's Advisory Committee on Weather Control, Capt. Howard T. Orville, gave a résumé of the work accomplished under the direction of that committee and the program planned for the future. Captain Orville is continuing his interest in weather modification, as vice-president of Beckman & Whitley, San Carlos, Calif. The work started by the President's Advisory Committee was transferred to the National Science Foundation in July 1958, by Public Law 85-510. A program of atmospheric sciences has been set up, with grants totaling $1,380,000. A dozen projects are involved, attacking modification from various angles. Captain Orville listed the following objectives of future studies:

1. Improve present techniques used in cloud seeding.
2. Increase our understanding of the precipitation processes.
3. Substantially increase the snow pack in the Western mountain regions.
4. Provide additional water to the Prairie States and eventually alleviate drought conditions.
5. Establish criteria to tell when to seed and when not to seed.
6. Prevent or reduce the hazards of hail, lightning, and tornadoes.
7. Develop methods for suppression or diversion of destructive hurricanes.

The Irrigation and Drainage Division plans to group and reproduce the papers and discussions presented during the Weather Modification Conference at an early date.

Tellers Canvass Ballot for 1960 Officers

New York 18, N. Y.
September 15, 1959

To the 1959 Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to count the Election Ballot for Officers of the Society report as follows:

For President
(Term October 1959—October 1960)

Frank Alwyn Marston	11,662
Scattering	16
Void	10

For Vice-President—Zone I
(Term October 1959—October 1961)

Charles B. Molineaux	2,141
Scattering	18
Void	152

For Vice-President—Zone IV
(Term October 1959—October 1961)

Lawrence A. Elsener	3,289
Scattering	34
Void	249

For Director—District 1
(Term October 1959—October 1962)

Elmer K. Timby	1,172
Scattering	19
Void	93

For Director—District 4
(Term October 1959—October 1962)

Samuel S. Baxter	579
Scattering	8
Void	29

For Director—District 8
(Term October 1959—October 1962)

Thomas M. Niles	398
Walter D. Linzing	369
Scattering	6
Void	6

For Director—District 11
(Term October 1959—October 1962)

Trent R. Dames	1,972
Scattering	18
Void	128

For Director—District 14
(Term October 1959—October 1962)

Woodrow W. Baker	467
Scattering	8
Void	15

For Director—District 15
(Term October 1959—October 1962)

Bernhard Dornblatt	766
Scattering	6
Void	64

Ballots counted	23,694
Ballot envelopes rejected Without signature	77
Dues arrears	85

Respectfully submitted,

Robert C. Johnston, *Chairman*
Joseph N. Rizzi, Jr., *Vice Chairman*

Thomas K. A. Hendrick
Richard C. Miller
Samuel J. Najarian
William D. Patterson
John C. Rutigliano
James B. Sullivan

Tellers

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES: *1960 contest closes May 1, 1960. See 1959 Official Register, page 143, and July 1959 issue of CIVIL ENGINEERING, page 66.*

FREEMAN FELLOWSHIP: *1960-61 (closing date pending). See Official Register, page 154.*

ERNEST E. HOWARD AWARD: *Closing date Feb. 1, 1960. See Official Register, page 142.*

ASCE RESEARCH FELLOWSHIP: *1960 contest closes January 1, 1960. See Official Register, page 156.*

J. WALDO SMITH HYDRAULIC FELLOWSHIP: *1961-62 (closing date pending). See Official Register, page 156.*

Campaign in ASCE Sections

Local Section	Quota %	Local Section	Quota %
	Winners		
South Idaho	144	Kansas City	109
Cincinnati	141	Kentucky	109
Indiana	134	Arizona	108
Lehigh Valley	132	Central Pa.	106
Philadelphia	128	Puerto Rico	106
Columbia	127	Delaware	105
Rochester	123	Tri-City	105
West Virginia	120	Central Ohio	103
Hawaii	119	Nashville	103
Ithaca	114	Wisconsin	102
	On the Way		
Rhode Island	98	Tacoma	85
Georgia	93	Illinois	83
Connecticut	91	Nebraska	81
Maine	91	Central Illinois	78
Iowa	88	San Francisco	78
Tenn. Valley	87	Texas	75
Metropolitan	85		
	Need a Boost		
Syracuse	74	Mid-Missouri	57
Sacramento	70	Mid-South	57
Panama	69	Akron	54
Maryland	68	Mohawk-Hudson	52
Spokane	67	Cleveland	51
Duluth	65	Toledo	50
Massachusetts	65	San Diego	49
Pittsburgh	65	South Carolina	48
Buffalo	63	Intermountain	47
Dayton	62	Montana	46
St. Louis	62	Los Angeles	43
Seattle	62	Venezuela	43
Kansas	59	Virginia	40
North Carolina	59		
	Latecomers		
Alaska	39	New Hampshire	32
Oklahoma	39	Mexico	28
Oregon	39	South Dakota	28
New Mexico	37	Wyoming	28
Nat'l Capital	36	Florida	27
Northwestern	36	Alabama	25
Miami	35	Louisiana	22
Michigan	33	Brazil	11
Colorado	33	Rep. Colombia	10

New Movies Available To Society Groups

Four interesting films have been made available to ASCE for loan to Student Chapter, Local Section, and civic groups. All are 16-mm, color films with sound. Titles are as follows:

1. **Testing Asphaltic Materials** (running time 36 min.), from the Asphalt Institute
2. **From Byway to Superhighway** (running time 16½ min.), from the Asphalt Institute
3. **A Bridge (the Walt Whitman) Is Born** (running time 28 min.), from the Delaware River Port Authority
4. **Iron Ore from Labrador** (running time 25 min.), from Armco Drainage & Metal Products

Available also are 38 slides with keyed talk prepared by the Irrigation and Drainage Division on subjects of interest to the Division.

Since only single prints are avaliable, loans will be made on a first-come, first-served basis. Requests should be addressed to the Executive Secretary at ASCE headquarters.

Professional Growth of Younger Members

Condensed From Final Report of Committee on Engineering Education, Los Angeles Section

A desire to increase his formal education and to become a registered professional engineer is typical of the younger ASCE member in the Los Angeles Section. Responding to a recent questionnaire conducted by the Section's Committee on Engineering Education, three-quarters of the 607 respondents stated that they were satisfied with the physical, intellectual, and ethical environment provided by their employers. However, the survey indicated that employers seem to fall down in the specific fields of professional growth. As for salaries, the opinion was widely held that, although starting salaries are fully adequate in all types of work, a ceiling is reached after about ten years and the experienced engineer is likely to earn only about three-quarters of what he is worth.

In the Los Angeles Section, the local Committee on Engineering Education is charged with recommending to the Section a program that will meet the continuing educational needs of its members and further their professional growth. The primary focus of such a charge is, of course, the younger member, who is the most concerned with professional growth and advancement.

In order to identify the "felt needs" of these younger members, it was proposed in 1956 to conduct a survey of the then Junior Members of ASCE (those who paid only their national dues as well as those who paid both national and local dues) within the geographical purview of the Section. The survey questionnaire was to cover the following points:

1. Personal identification: age, experience, education, type of work, and specialized interest in civil engineering.
2. Employment conditions: type and location of employer, encouragement of professional growth, and salary.
3. Professional growth: registration, supplementary education, educational needs, and attendance at professional meetings.
4. Role of ASCE: recommended improvements in Los Angeles Section service, and economic interests.

Of the 1,105 copies of the Professional Growth Survey questionnaire mailed out, 55 percent were returned. Of these 329 came from members who paid both local and national dues and 278 from members who paid only national dues.

The reader is reminded that the survey was conducted in the spring of 1957, so the numerical figures for salaries will need adjustment before comparison with present-day values. Taken as a whole, however, the Professional Growth Survey is believed to be a valid representation of what the younger group of the civil engineering profession in the Los Angeles area thinks of itself, and what it sees as its opportunities for growth within the profession.

Personal Identification

A frequency distribution for the age and experience of all questionnaire respondents is shown in Fig. 1. The total of the sub-groups does not always add up to 607, as in some cases no answer was given. At other times the respondent may have checked more than one answer. As a convenient reference point in gauging this survey, it will be helpful to keep in mind the fact that 281 men, or just over 46 percent of the respondents, were under 30 years of age.

An interesting facet of this distribution is the 78 men who were over 34 years of age. These represent veterans who had been given an extension of the customary upper limit of 32 years for Junior Membership.

Approximately 80 percent of the group surveyed were veterans, and of these just about half had done stints of three years or longer. This is probably not greatly different from the distribution for the corresponding U.S. male population as a whole, but it does serve to point up what a bite is taken out of a young man's professional career by military service. Of course the military experience may also have been engineering experience, in which case it was included in the experience indicated in Fig. 1.

The educational background and aspirations of the respondents was the subject of one of the questions. It was noted that 269 men, or about 44 percent, had a B.S. degree but did not plan to go farther. Another 36 percent, or 221, had a B.S. and planned to take an M.S. at least, and possibly more. Of the group 13 percent already had an M.S., one quarter of whom planned to go on for the Ph.D.

Response to the question, "For whom do you work?" (Fig. 2), shows that 43 percent of the group queried worked for some public agency, either at federal, state, county, or municipal level. Private industry came next, with 23 percent, while just one man in six worked for a consulting engineer. The distinction between consulting engineer and private industry, often a close one, was supposedly based upon the source of the firm's profit. If it was made from engineering designs or services, the employer was considered as a consulting engineer. If, however, the profit was made from a manufactured or processed product the employer was classified as a private industry.

The fact that only three men were to be found in the education field may be somewhat alarming. The explanation for this, however, lies more likely in the fact that there are not many men in the engineering education field who are under 27, and that those reaching this age generally apply for the grade of Member, being eager to attain this mark of advancement.

As to the type of work by function, Fig. 3 shows that just over half of the respondents were in some type of design work. Another one-sixth were in construction, while one-eighth were in research and development. The remaining fields of management, operation, sales promotion, and the like account for less

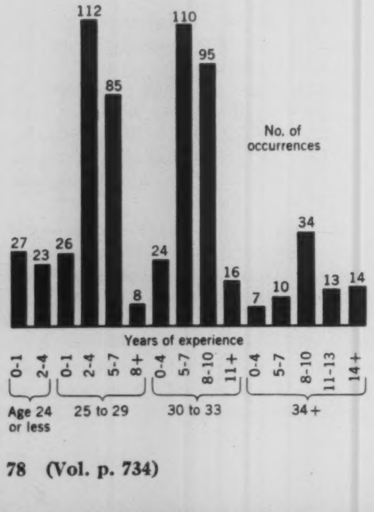


Fig. 1. Age and experience of all respondents to questionnaire.

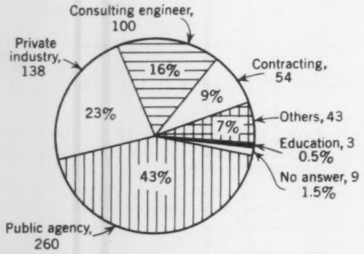
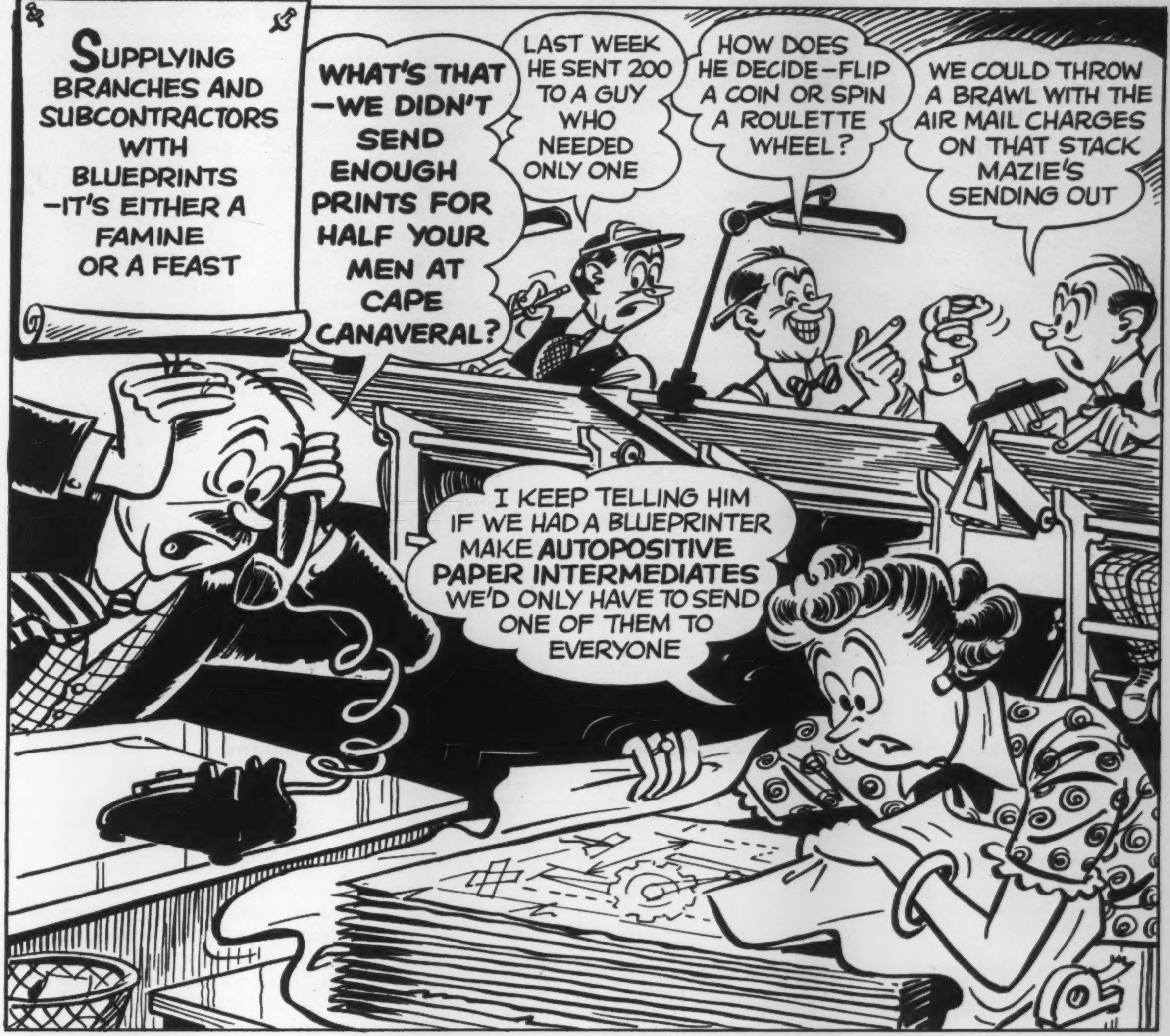


Fig. 2. Type of work—classified according to employer.

THERE MUST BE AN EASIER WAY



SUPPLYING BRANCHES AND SUBCONTRACTORS WITH BLUEPRINTS —IT'S EITHER A FAMINE OR A FEAST
WHAT'S THAT —WE DIDN'T SEND ENOUGH PRINTS FOR HALF YOUR MEN AT CAPE CANAVERAL?
LAST WEEK HE SENT 200 TO A GUY WHO NEEDED ONLY ONE
HOW DOES HE DECIDE—FLIP A COIN OR SPIN A ROULETTE WHEEL?
WE COULD THROW A BRAWL WITH THE AIR MAIL CHARGES ON THAT STACK MAZIE'S SENDING OUT
I KEEP TELLING HIM IF WE HAD A BLUEPRINTER MAKE AUTOPOSITIVE PAPER INTERMEDIATES WE'D ONLY HAVE TO SEND ONE OF THEM TO EVERYONE

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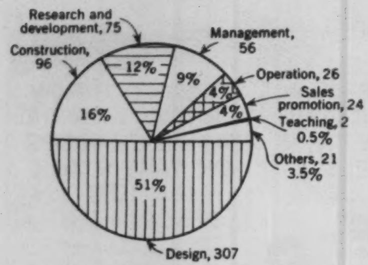


Fig. 3. Type of work—classified according to function.

than one-quarter. The engineering education picture is even "darker" than it seemed since only two of the three men in the field were actually engaged in teaching.

With regard to registration, the survey showed that more than four-fifths of the respondents either have some type of registration or are preparing for it. Some 42 percent of the men already had their professional licenses in hand. Respondents were asked to indicate their reasons for desiring registration, whether they were registered or not. The predominant reason seems to be that registration is required for advancement. The simple desire for advancement comes next, while the desire to practice in one's own name is third. Many respondents simply checked all three reasons.

In order to get a distribution of the particular civil engineering interests represented, the respondents were asked to check their first and second interests among the groups comprising the Technical Divisions of ASCE. Over half proved to be interested in the structural and construction fields, while the interests of the rest were divided among the remaining ten groups, with hydraulics and highways leading and waterways and air transport at the bottom of the list. Railways would have been included in the 26 men replying "Other."

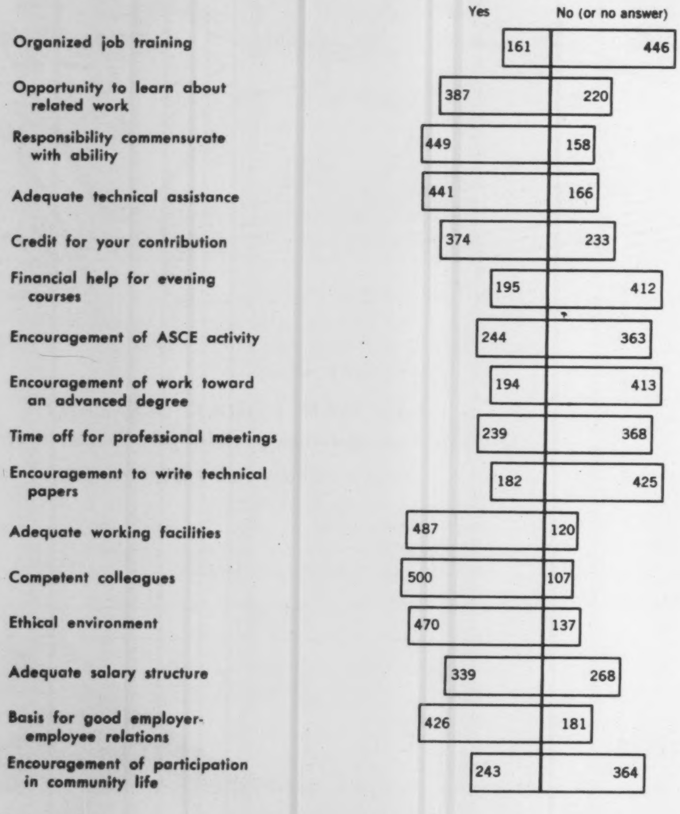
Professional Growth

As a first question on the subject of professional growth, each respondent was asked simply what part of his current employment (in time required to perform) was in professional, subprofessional, or non-engineering categories. The results show that 54 percent felt they were spending more than half their time in professional work. About one-tenth each indicated that more than half their time was spent in subprofessional or non-engineering work, while the remaining 26 percent gave no answer or showed no one category claiming more than 50 percent of their time.

The Junior Member was next asked to evaluate his employer on 16 separate counts of professional growth. These results, on a straight "yes or no" basis, are shown in Fig. 4. Unfortunately it was not possible to code the survey to distinguish between "no" and "no answer," but the great majority of respondents indicated a definite answer in all categories. It will be noted that some of the questions involve only simple fact such as, for example, organized job training, while others involve thoughtful evaluation, such as the matter of responsibility commensurate with ability.

It may be remarked that this question was broken down into type of employer, and that private industry leads the field in general. This category was slightly edged out by "public agency" and "consulting engineer" in the matter of adequate working facilities and ethical environment. The consulting engineer also was found to be just twice as active as any other employer in encouraging ASCE activity.

Fig. 4. Evaluation of employer as to professional growth opportunities.



Salary Matters

The first of four correlated studies on salary is shown in Fig. 5, where the median monthly salary in each of the bar-groups of Fig. 1 is plotted vs. experience for the two general age groupings—under and over 30. To illustrate how this graph is constructed, consider the 23 men of age 24 or less having two or four years of experience, and the 112 men of age 25 to 29 with the same experience. These two groups together comprise a 135-man population, for which the median salary was about $525 per month. Thus this figure is plotted for an abscissa of 3 years experience, the mean of 2 and 4. All other points on the graph were constructed in the same way.

It will be noted that the older men have a slight advantage over the younger men with the same experience, but that a couple of years of experience seems to make up for whatever inherent difference there is in being under or over 30.

The respondents were also asked in a separate question what they felt to be an adequate salary for a civil engineer starting out with a B.S. degree—with five years experience, and with ten years experience. These points are also shown in Fig. 5, connected by the rapidly rising line at the left. Of interest here is the good agreement between fact and fancy at experience levels of less than two years, while for the more experienced

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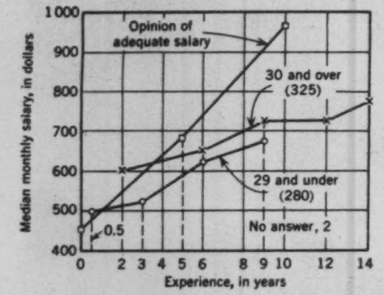

Fig. 5. Variation of salary with experience for all respondents, divided into age groups.

employees the opinion as to what constitutes adequate salary runs some 31 percent higher than the actual median.

A correlation of salary vs. type of employer was made from results in the survey. In all employer categories, the modal salary ran to about $625 per month (April 1957). The public agency distribution was a little on the low side, while the consulting engineer and contractor show a few spurts on the high side.

The frequency distribution of salary as a function of engineering education is shown in Table 1. It is difficult to draw a general conclusion here except to observe that the median salary increases consistently with education and planning for further education, except in the case of the man with a B.S. degree who is planning to take an M.S. For some reason, not discernible in this survey, his plan for self-improvement at this level puts him at a financial disadvantage!

Table 1. Variation of Salary with Engineering Education and Plan

Size Sample	Degree	Plan	Median Salary
269	B.S.	None	$625
221	B.S.	M.S.	575
59	M.S.	None	650
21	M.S.	Ph.D.	675
4 (not shown)	Ph.D.		750
33 (other and no answer)			

Table 2. Educational Needs Felt by All Respondents

Subject	First Choice	Second Choice	Third Choice	Total
Technical	220	75	76	371
Business and adminstration	177	159	89	425
Public speaking ..	74	115	106	295
Writing	53	120	109	282
Humanistic and social science	46	69	79	194
Other	13	8	7	28
No answer	24	61	141	226

Engineering Education and Growth

A breakdown of the civil engineering interest with the educational background revealed that the field of engineering mechanics claims the highest percentage of advanced degrees and also the highest percentage of men with the B.S. degree who are ambitious for further academic training. Following engineering mechanics come sanitary engineering, hydraulics, soil mechanics, and structural, in that order, all with more than 50 percent of their B.S. men aspiring for a M.S.

Equally significant is a correlation of work by function vs. engineering education. As might be expected, the research and development category claims the highest percentage of advanced degrees and aspirants. The design group, however, claims that just about half of its B.S. holders aspire to an M.S. degree, while the management groups is not far behind. Only in the construction and sales categories do the B.S. men without plans or further degrees make up more than half the group surveyed.

From the standpoint of this committee, perhaps the most important question related to the educational needs felt by the respondents. First, second, and third-rank needs are shown in Table 2. Although the technical group claims the highest number of first-rank choices, the business and administration category has the highest total of the three ranks. Public speaking and writing are at about a standoff for second and third ranks, while the humanistic and social science needs are placed last.

The manner in which the respondents are supplementing their formal education was also brought out in the survey. More than three-quarters took some kind of organized course either regularly or irregularly and attended conferences or symposia regularly or irregularly. In the matter of self study and reading, however, about two-thirds indicated that they had no systematic program of study.

In this unsystematic self-study and reading program, then, what do the younger members read? About two-thirds read both Civil Engineering and the ASCE Proceedings, while one-quarter read Civil Engineering only, and 2 percent read Proceedings only. Also approximately two-thirds read other technical literature.

Participation in ASCE Activities

Returns from a question concerning the attendance of younger members at regional and national meetings showed that about 22 percent of the respondents attend regional meetings of ASCE either regularly or irregularly, and half of them attend other society meetings as well. Another 18 percent attend regional meetings of other societies but not those of ASCE. On a national scale, some 6 percent of the respondents indicated that they attend ASCE national meetings while another 7 percent attend national meetings of other societies but not those of ASCE. It is likely that these responses are largely the result of the geographic location of the various national meetings, and that not too much of a conclusion can be drawn from them.

More significant from the standpoint of the Local Section is the matter of younger member attendance at meetings of the Los Angeles Section. Claiming regular or irregular attendance at the general or Branch meetings were 42 percent of the respondents (or 25 members), technical group meetings 34 percent, and Junior Member Forum meetings 23 percent. Since the total attendance at Section meetings is on the order of 150 to 250, it is clear that the indicated younger member participation is a good deal more irregular than it is regular.

The primary reason given for poor attendance is given as "too busy" or "conflicting activities," which is not surprising. It is of interest to note that fewer than 10 percent of the respondents indicated that the cost was a reason for poor attendance.

In an endeavor to find in what fields of activity the younger members felt the Los Angeles Section could improve its services, the questionnaire asked for a ranked interest in some nine different areas of activity. From the response it is clear that salary matters ranked highest, followed closely by public relations and professional and ethical standards. Falling in the lowest rank is "the role of the Junior Member"!

Finally the straightforward question was put: "Which of the following organizations do you believe should protect and promote your professional interests as an engineer (including your economic interests)?" The overwhelming response here is that ASCE should undertake this obligation. A unity organization comes next, followed by a professional collective bargaining unit with trade unions coming at the bottom with less than ⅓ percent.

Supplementary Comments

Noteworthy was the fact that almost 30 percent of the survey population (175 individuals) took the trouble to set down additional thoughts on the questions raised by the survey. The most prevalent comment pertained to public relations. Nineteen respondents wanted ASCE to put the civil engineer before the man in the street—via news releases, films, speakers bureaus, etc.—while four of the group expressed willingness (on their

Capital AIRLINES

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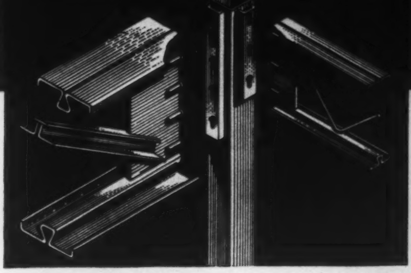

Question: What do these companies have in common?

Answer: They built with Macomber V-LOK Steel Framing — saved erection time and costs — assured earlier occupancy and faster investment returns.

Macomber V-LOK is rugged, strong, versatile. It can solve your steel framing problems, too. Write for additional information.

Do you have the Warehouse Design Manual?

Designing
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MACOMBER

CANTON 1, OHIO

own initiative) to see ASCE dues raised as necessary to include such a service. Five more said public relations are needed "within the family" to inform civil engineers about the history and importance of their profession.

Eighteen individuals urged ASCE to promote higher salaries, especially for the truly professional and experienced engineer. The young civil engineer, althought adequately paid upon graduation, has difficulty in finding engineering jobs to which he can aspire conomically. Seventeen asked for a reorganization of ASCE along the lines of the American Medical Association, with consequent stiffening of professional standards (ethics, fees, limitation of graduating engineers, registration laws with teeth in them). Another 14 respondents asked substantially the same sharpening of standards for ASCE, but without reference to the AMA.

With regard to trade unions and the ASCE, five men remarked that unionization would bring engineering down from a professional level to a trade level, while another thirteen held that ASCE must act to gain economic advantages for its members. Otherwise, young engineers will have no choice but to join unions. Five others expressed the view that neither ASCE nor any union can bargain for the true professional. He must stand on his own feet and make his own way with his employer. Finally, two respondents expressed the belief that unions are making rapid progress with professional employees and can best handle the economic interests of the civil engineer.

Many comments pertained to the structure of ASCE itself. Eight expressed the belief that the management of ASCE is practically a closed corporation of employers of civil engineers, with meaningless elections. Employers cannot raise salaries without raising fees and this they appear unwilling to do, therefore ASCE makes no progress in salary matters.

On the specific subject of engineering education, three respondents want ASCE to promote a five-year program leading to the B.S. degree—the extra year to be devoted largely to the humanities (though not all at once). One respondent wanted ASCE to sponsor night classes, refresher courses, etc. Another unwittingly summed up the "Grinter Report" (of ASEE) in his comment that the greatest trouble with engineering education today is that there is too much "know how" and not enough "know why." Remaining remarks—mostly specific requests—varied widely, from asking ASCE to establish more branches to asking ASCE to take greater cognizance of civil engineers in the aircraft, missiles, and nuclear power fields.

Acknowledgments

For leadership and assistance in the preparation and evaluation of the survey questionnaire, the Committee is deeply indebted to its past-chairmen, William J. Carroll and C. Martin Duke. Former committee members George Langsner and Kenneth Reynolds have rendered material aid in seeing the survey through various stages. Members of the Los Angeles Section Junior Member Forum assisted in coding the survey cards. Finally, the constructive criticism of the committee's two consultants, ASCE Director Finley B. Laverty and Jack E. McKee, chairman of the ASCE Committee on Engineering Education, has provided much needed and appreciated counsel and encouragement.

COMMITTEE ON ENGINEERING EDUCATION
Los Angeles Section, ASCE

Alfred C. Ingersoll, *Chairman*
Alfred L. Himelhoch
Dale E. Goss
James J. Kesler
Robert C. Merz
Daniel E. Whelan

[After reviewing this article Prof. Alfred C. Ingersoll, chairman of the Los Angeles Section Committee on Engineering Education, wrote "The thing that concerns me is the extent to which the respondents to our survey actually represent 'the young members' in the civil engineering profession in this area. Many of the most eager and enterprising young civil engineers apply for the next available grade of ASCE membership as soon as they are old enough. As of two years ago, many of those 27 and older had become Associate Members and were not reached in this survey. We consider this to be the chief reason why so few of the respondents were in engineering education. In the original report the respondents were referred to as Junior Members. Since this classification is no longer used, the term 'younger member' has been applied to the group. It is anybody's guess whether these men (half of whom were over 30) were truly representative of the civil engineering profession in that classification.

"In our desire to strengthen ASCE service to the younger members, however, we are certain that it is the 55 percent who replied to the questionnaire that will respond favorably to any moves for improvement of ASCE. Therein, we feel, lies the greatest strength and validity of the survey."]

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.13	1.13
Baltimore	1.14	1.12
Boston	1.22	1.18
Chicago	1.43	1.36
Denver	1.21	1.21
Houston	1.26	1.26
Kansas City	1.16	1.11
Los Angeles	1.23	1.21
Miami	1.57	1.57
New Orleans	1.18	1.03
New York	1.28	1.25
Pittsburgh	1.04	0.95
Portland (Ore.)	1.25	1.16
San Francisco	1.24	1.24
Seattle	1.06	1.06

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	0.90	0.92
II, Mid Atlantic	1.14	1.13
III, Mid West	1.22	1.16
IV, South	1.14	1.08
V, West	1.03	1.02
VI, Far West	1.13	1.11

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current salary total for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930. This is the total of salaries paid in 1956 for the equivalent Federal Grades GS5, GS7 and GS9. Only the annual base entrance salaries are used in these calculations. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was July 31, 1959.

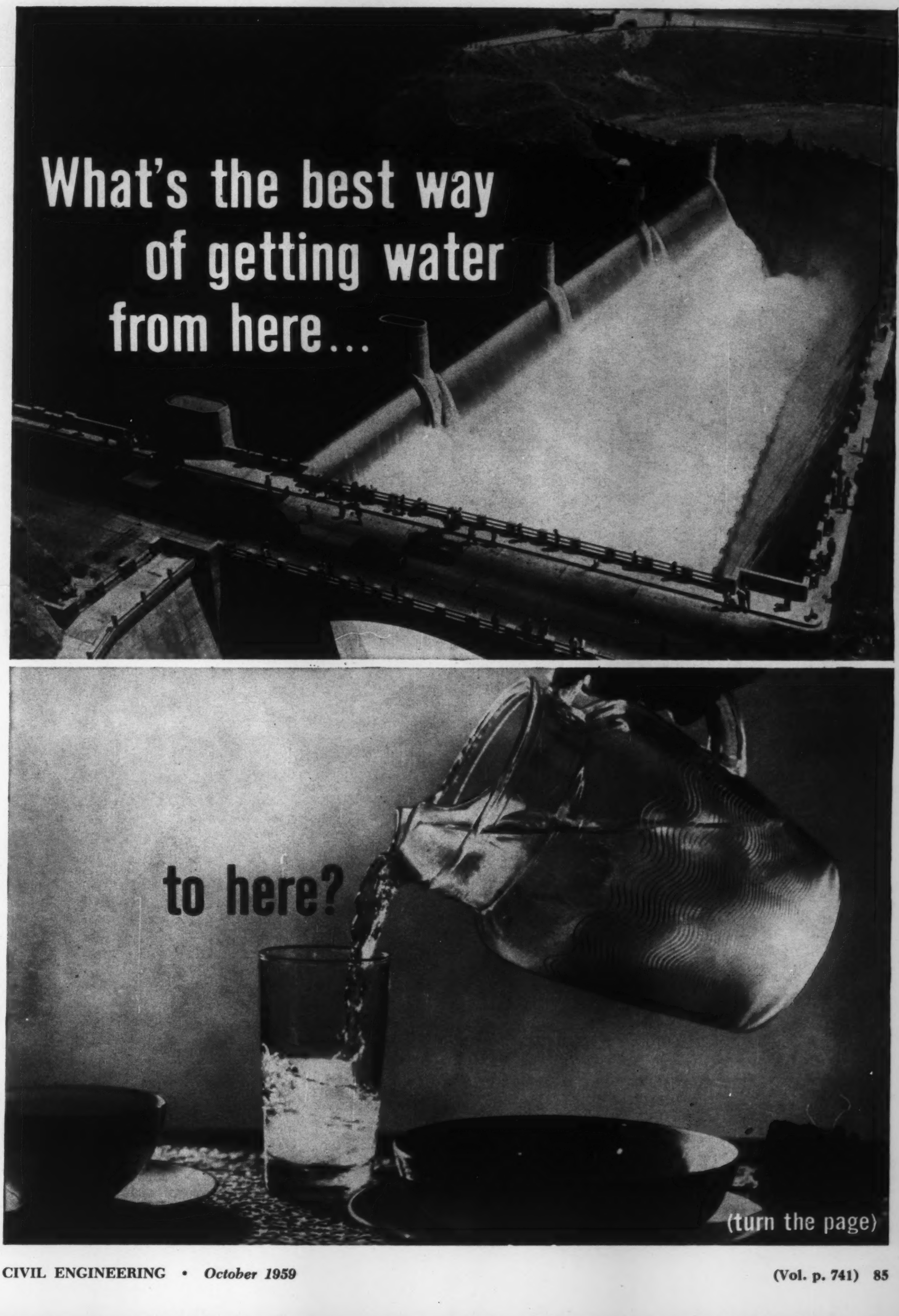
Henry Heald, F. ASCE Wins Hoover Medal

This year's Hoover Medal will go to Henry Heald, F. ASCE, president of the Ford Foundation. A distinguished educator, Dr. Heald was president of the Illinois Institute of Technology and New York University before assuming the presidency of the Ford Foundation.

The Hoover Medal was founded in 1929 to honor the civic and humanitarian achievements of former President Herbert Hoover, Hon. M. ASCE. It will be presented to Dr. Heald at the Wednesday banquet during the ASCE Convention.

ASCE Membership as of September 9, 1959

Fellows	10,826
Members	15,673
Associate Members	17,426
Affiliates	92
Honorary Members	47
Total	44,064
(September 9, 1958	42,111)


What's the best way of getting water from here...
to here?
(turn the page)

CAST IRON PIPE

America's greatest water carrier

Roadside installation of 8-inch mechanical joint cast iron pipe for gas utility main extension.

Why do we say that?

This year, as every year, more miles of underground cast iron water mains are in use than all other kinds of pipe combined.

Furthermore, more miles of cast iron water mains are now being purchased and laid than of any other kind of pipe.

Yes, cast iron is always the favorite. A recent impartial survey showed that consulting engineers and water utility officials prefer cast iron pipe for underground water distribution by an overwhelming majority.

36-inch mechanical joint cast iron water main rerouted because of superhighway construction.

Section of 16-inch gas transmission main being installed through a new subdivision.

Municipal water improvement program included installation of 35,000 feet of 42-inch mechanical joint cast iron pipe (above) and 9280 feet of similar 30-inch pipe.

Supplemental water supply line for municipal water authority uses 13,500 feet of 16-inch pipe.

What are its advantages?

- LONG LIFE. The cast iron pipe you install today will be performing economically a hundred years from now.
- HIGH-CAPACITY FLOW. Cement-lined cast iron pipe will deliver the full-rated flow all through the years. No other pipe, size for size, can carry more water.
- CORROSION RESISTANCE. Long life proves it. Most water utilities are still using the first cast iron pipe they installed.
- GREAT BEAM STRENGTH. Cast iron pipe resists the effect of heavy traffic, shifting soils.
- TREMENDOUS LOAD RESISTANCE. Six-inch cast iron pipe (Class 150) withstands a load of nearly nine tons per foot!
- PRESSURE-TIGHT JOINTS. You have a complete choice of leakproof, easy-to-assemble joints. You need a minimum of tools and work crew.
- EASE OF TAPPING. No tapping saddles needed. Takes threading best of all kinds of pipe.

. . . good reasons for you to choose

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

Write for complete information to Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Ill.

ASCE CONVENTIONS

ANNUAL CONVENTION

Washington, D. C.
Hotel Statler
October 19-23, 1959

NEW ORLEANS CONVENTION

New Orleans, La.
Jung Hotel
March 7-11, 1960

RENO CONVENTION

Reno, Nev.
June 20-25, 1960

TECHNICAL DIVISION MEETINGS

SANITARY ENGINEERING CONFERENCE

Cincinnati, Ohio
Netherland-Hilton Hotel
January 8-11, 1960

Sponsored by
Sanitary Engineering Division

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

Boulder, Colo.
University of Colorado
June 13-17, 1960

Sponsored by
Soil Mechanics and
Foundation Division

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by
Hydraulics Division

LOCAL SECTION MEETINGS

Illinois—Weekly luncheon meetings at the Engineers' Club, Chicago, every Friday, at 12 noon.

Kansas City—Regional conference on construction at the Continental Hotel in Kansas City, Mo., November 12-13. The general conference theme will be "Mid-Century Construction . . . What's Right? Wrong? New?"

Metropolitan—Joint meeting with the Associate Membership in the auditorium of the Engineering Societies Building, October 21, at 7 p.m.

Mid-South—Fall meeting at the Heidelberg Hotel, Jackson, Miss., October 15-17.

Sacramento—Weekly luncheon meetings at the Elks Club every Tuesday noon; regular dinner meeting of the Central Valley Branch on the fourth Wednesday of every month, at 6 p.m.

Tennessee Valley—Annual meeting at Knoxville, Tenn., November 13-14. The Knoxville Branch will be host.

Division Doings

Surveying and Mapping Division

The Division's Task Committee on Status of Surveying and Mapping has been developing a basis for negotiation of map and survey contracts to replace competitive price bidding. This important activity is outlined here by Brother B. Austin Barry, chairman of the Task Committee on Status of Surveying and Mapping.

One particular consequence of the ASCE Board of Direction's action of February 1959 in declaring surveying and mapping to be professional engineering in nature concerns a new procedure to secure surveying-mapping contracts. Heretofore, competitive price bidding has not been uncommon, but the clear implication of the Society's action is that such work, if professional, should not be so handled. The alternative procedure is negotiation.

The basis for negotiation must be fair and equitable, based upon objective and determinable factors, and such a set of factors is now being sought by the Task Committee on Status of Surveying and Mapping. To make possible the estimating of a fee for a topographic mapping or other surveying job, there seems to be need for either a range of per diem charges for individuals or teams so engaged, or else, where feasible, a range of fees for mapping predicated on scale, contour interval, type of terrain, extent of area, etc. The Task Committee expects to report its findings and suggestions very soon, and will discuss the question during the October Convention in Washington. It is believed that a date early in 1960 should be set as the final date for all to conform to the new mode of acquiring or providing engineering services of mapping and/or surveying.

Meanwhile, the Executive Secretary's Office has by letter been bringing to the attention of state and federal public works and similar agencies as occasion warrants, the proposed more desirable form of securing mapping and surveying services. These agencies indicate generally a willingness to comply with the new plan with regard to securing topographic mapping and hiring survey personnel. Private engineering firms and practitioners will also be asked to abide by the Engineer's Code of Ethics and negotiate rather than bid for such professional services.

The clarification of this long-nebulous area of engineering operation should be welcomed by all concerned. It is hoped that in the next few months the new procedure will be universally accepted and employed.

City Planning Division

The City Planning Division has just organized a technical committee to study the terminology used in the practice of civil engineering. Its specific objectives will be to define terms used in planning, define the substance of the terms, and prepare a manual of practice on the subject. The new "Technical Committee on Terminology Used in the Practice of City Planning" will be headed by Sergei Grimm. J. A. Salvato, Jr., is secretary, and the other members are William Hedley, Norman Kennedy, and J. Cal Callahan.

ASCE-AGC Joint Cooperative Committee meets in ASCE Board Room to discuss revision of the ASCE-AGC "Suggested Form of Contract for Use in Connection with Engineering Construction Projects." Seated around the table (going from left to right) are E. J. Wheeler (AGC); W. R. Hellwig (AGC); C. H. Mattoon, AGC co-secretary; H. D. Dixon, AGC co-chairman; C. B. Molineaux, ASCE co-chairman; Don King, ASCE co-secretary; W. W. Wanamaker (ASCE); and D. B. Ventres (ASCE).

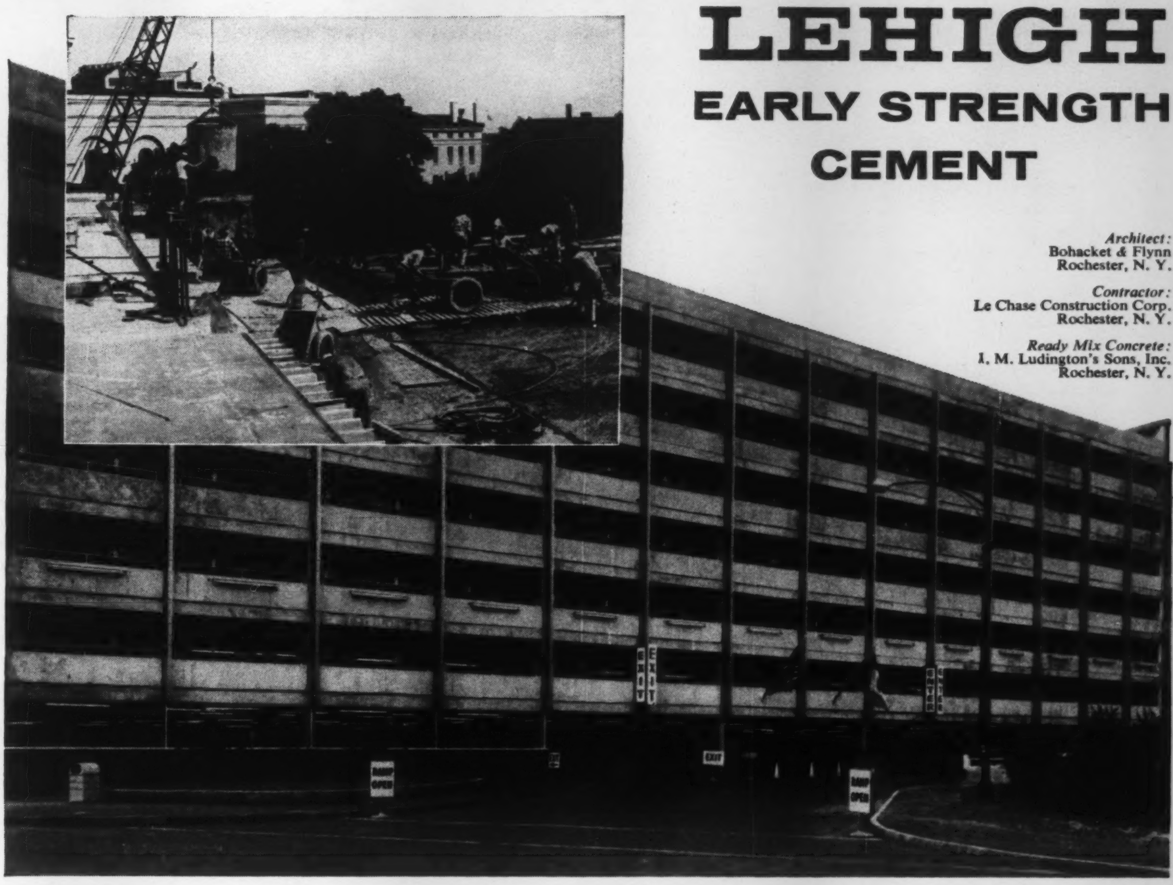
Rochester adds another concrete parking ramp made with

LEHIGH
EARLY STRENGTH CEMENT

Architect:
Bohacket & Flynn
Rochester, N. Y.

Contractor:
Le Chase Construction Corp.
Rochester, N. Y.

Ready Mix Concrete:
I. M. Ludington's Sons, Inc.
Rochester, N. Y.



Eight parking levels contain 551 metered spaces. Motorists park their own cars, taking advantage of such modern features as automatic coin changers, passenger elevators and a counting system which tells them where spaces are available.

- *The Clinton Avenue Parking Ramp* is another structure resulting from the forward thinking of the City of Rochester, N. Y. Because of the ramp, 551 more cars have been removed from the curbs of busy downtown streets.

For the second time in 26 months (the city's 523 car Mortimer Street Parking Ramp was completed in March '58) Lehigh Early Strength Cement was chosen for a big Rochester parking facility. The tight schedule called for placement of concrete during most of the Fall and Winter months. Work progressed so well that six floors were opened temporarily during the Christmas rush. After the holidays, concrete pouring was completed. The ramp has been producing full income since April.

This is another example of how Lehigh Early Strength Cement saves time and money in modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.

**LEHIGH
CEMENTS**

BY-LINE WASHINGTON . . . . .

The highway problem hasn't been solved, even though the program (as predicted) will keep rolling on a somewhat reduced basis. The 1-cent added gasoline tax will produce about $338 million in its first year—and that will leave a deficit of about $157 million in the Trust Fund (the excise tax diversion won't start for 21 months). That's why, in spite of permitted allocations of $1.8 billion of federal funds for next year, the states will be told to spread out their contract lettings, so all bills won't come due at the same time.

The Bureau of Public Roads can't pay out more than it has in the Trust Fund till. So for now, you can figure the money that will be available to the states for the next two years by taking 18/25ths of the amount allotted in the 1958 act (total, $2.5 billion). It means, in effect, a reduction of about $900 million in federal money available for two years.

Congress will just about have to revamp the whole highway program in 1961. That's when a whole series of reports is due from the BPR—on costs, lessons learned from test road operations, suggested user charges and the like—to give lawmakers a better basis for designing new taxes to support the huge road program. Thus action this year was in the nature of a makeshift, to tide the Trust fund over until a more permanent plan can be formulated.

A demonstration of lack of communication by engineers was dropped into the middle of final hearings in the Senate on the highway bill. Highway Administrator Tallamy—usually good at getting ideas across to laymen—used the term "contract control" to describe his plans to hold down state contract lettings. He meant "stretch out," but "contract control" brought four state-proud Senators down on his head, on the immediate assumption that he was going to tell the states what contracts could be let, and to whom. It took a half-hour of explanation to unscramble the mixup.

* * *

More time for applications for federal airport aid—or for revising applications already submitted—has been provided by the Federal Aviation Agency. The original deadline for federal money for fiscal year 1961 was September 1 of this year. The FAA has now moved the deadline date back to November 30.

* * *

Complications in government building construction work are inherent in a new public buildings law. There are three trouble-making provisions: (1) House and Senate Public Works committees must give express consent for any government construction project estimated to cost more than $100,000; (2) approval can be withheld for any construction or repair work when any group of 30 or more projects is authorized but not funded; and (3) projects for which Congress has voted no money, within the first year after they are authorized, may be cancelled by the Public Works committees. The purpose of course, is to bring construction work under tighter control and to remove the temptation for bureau heads to rush projects into construction stages, just to "use up" unexpended or authorized funds or authority.

The importance of overriding the public works veto is overrated, as far as construction effect is concerned. There was never any doubt that something near the $1.2 billion included in the bill would be put through anyway, even if only by the device of "continuing resolutions" of Congress. For engineers, the fact remains that the final figure is almost exactly what the President asked in his budget—even with inclusion of the 67 "new starts" that Eisenhower objected to (their effect on spending will come in future years). Thus the main effect is political and not on the construction industry.

* * *

Activities of the Coast and Geodetic Survey are to be expanded, under terms of a new law that removes present geographic limitations on the service's operations. Previously (under a 1947 law) the survey was limited to the U. S., its territories and possessions. But increasing need for data for use in oceanographic, space, and general military operations has brought a demand from other government agencies for Coast and Geodetic Survey services in areas beyond geographic limitations.

* * *

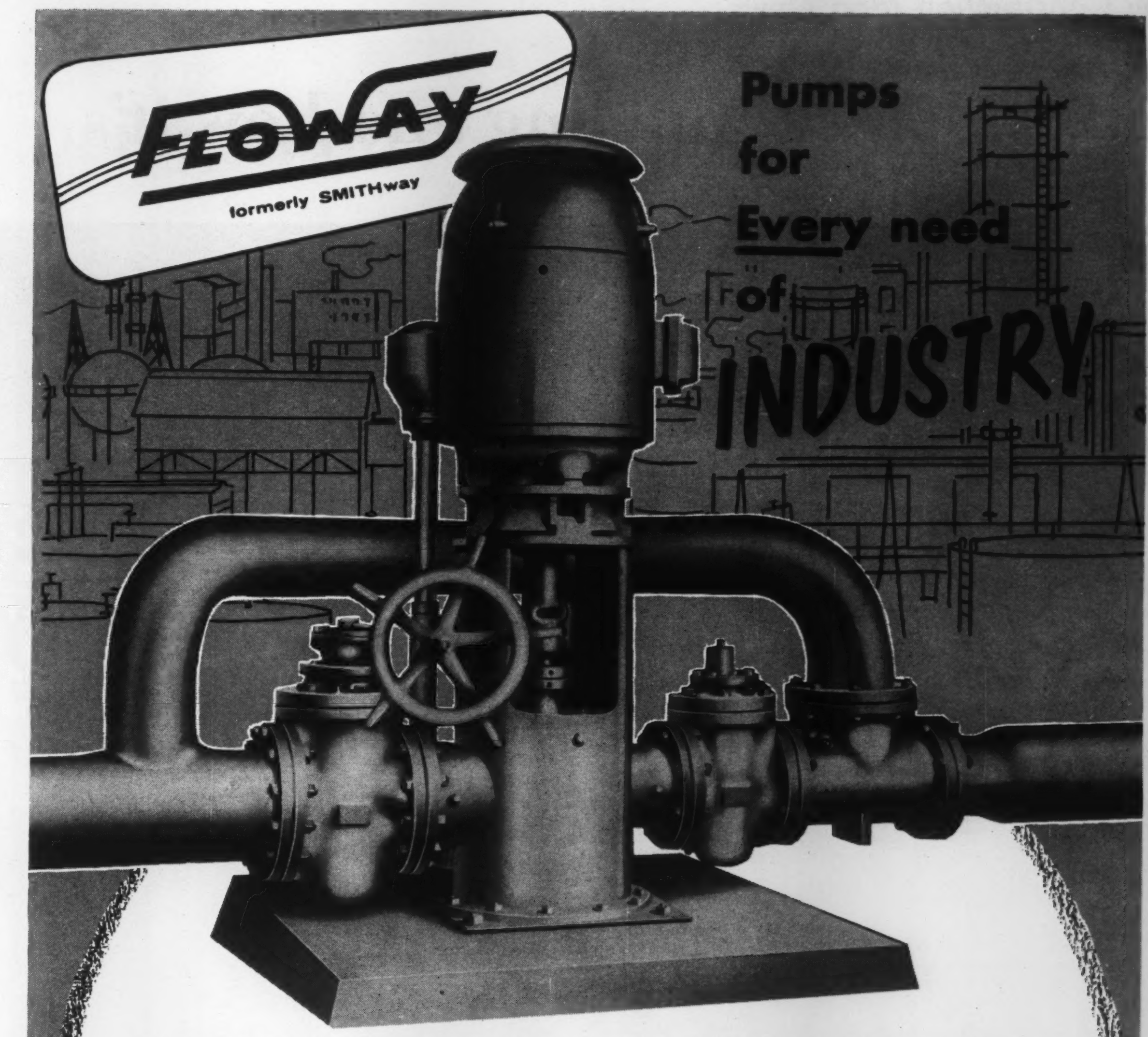
Hope of producing more scientifically trained personnel is behind the **National Science Foundation's newest program** to aid science-minded students in secondary schools and colleges and teachers. The program envisages summer science training courses for secondary-school students during 1960; research participation programs for college undergraduates; and similar research participation classes for science teachers. Colleges and universities interested can get full information by writing: Special Projects in Science Education Section, Scientific Personnel and Education Division, National Science Foundation, Washington 25, D. C.

* * *

The long debate over **diversion of Lake Michigan waters**—which ended when the whole proposal was referred back to a Senate International Affairs committee—developed two major points on which opposition was based: (1) The fear of Lakes cities and states that while diversion of even an additional 1,000 cfs at Chicago would lower lake levels very little (⅛ in. was the estimate), it would be only the start of Chicago's demands for more diversion later, and (2) the very real fear that Canada would be sufficiently disturbed to withdraw from the International Joint Commission which is now considering Canada's proposal to divert some 2.5 million acre-ft of Columbia River water from Canadian sources of the River.

* * *

The key point in the new housing act is the provision that the $650 million authorized for urban renewal work is to spread over two years—$350 million the first year, $300 million the next. That wasn't clear in the first two versions of the bill, both of which were vetoed. Other provisions concern FHA mortgage insurance, and the elimination of direct loans to colleges for classroom construction and equipment.



The tougher the job, the more you need a FloWay turbine pump for exacting performance year after year. Experience is the basic reason why FloWays are unsurpassed in the industrial field—experience in pump design . . in selection of superior materials . . in precision manufacturing . . in rigid inspection. This knowhow accumulated over two generations has set new standards of dependability wherever there are pumping problems to be solved.

Fiese & Firstenberger's FloWay turbine pumps carry a standard warranty and are supplied in a wide range of capacities—from 15 to 4,000 GPM with either standard cast iron or fabricated steel heads. Replacement parts are readily accessible from local sources to users in all parts of the world.

Inquire about the specific FloWay you need today. You'll find it's efficient . . rugged . . versatile . . economical.

Oakland, California
Pacific Pumping Company
San Francisco, California
Woodin & Little
Denver, Colorado
Harry J. Glass & Associates
Oakland Park, Florida
Peninsular Armature Works

Western Springs, Illinois
Water Well Engineers, Inc.
Baltimore, Maryland
R. Thum & Company
Buffalo, New York
Ralph Simmons & Company
New York, New York
Frank A. Kristal

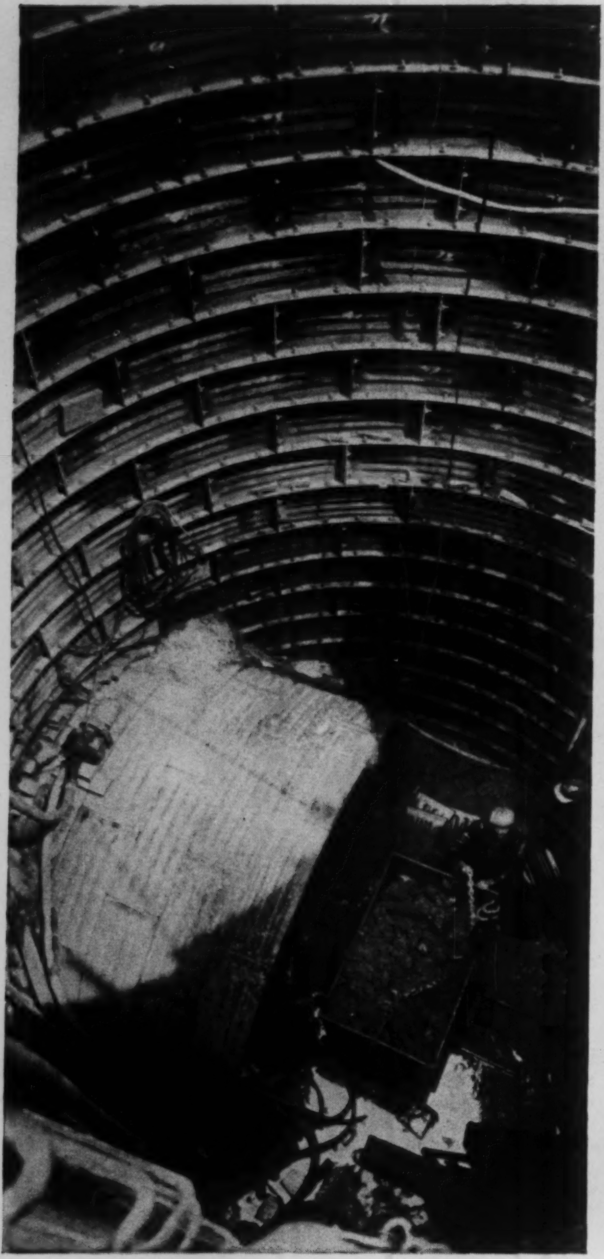
Cleveland, Ohio
W. J. Bryson Company
Tulsa, Oklahoma
The Kase Company
Portland, Oregon
Pacific Pumping Company
Ardmore, Pennsylvania
Weinman Pump Manufacturing Co

Pittsburgh, Pennsylvania
Weinman Pump & Supply Co
Houston, Texas
Pump & Power Engineering Co
Seattle, Washington
Pacific Pumping Company

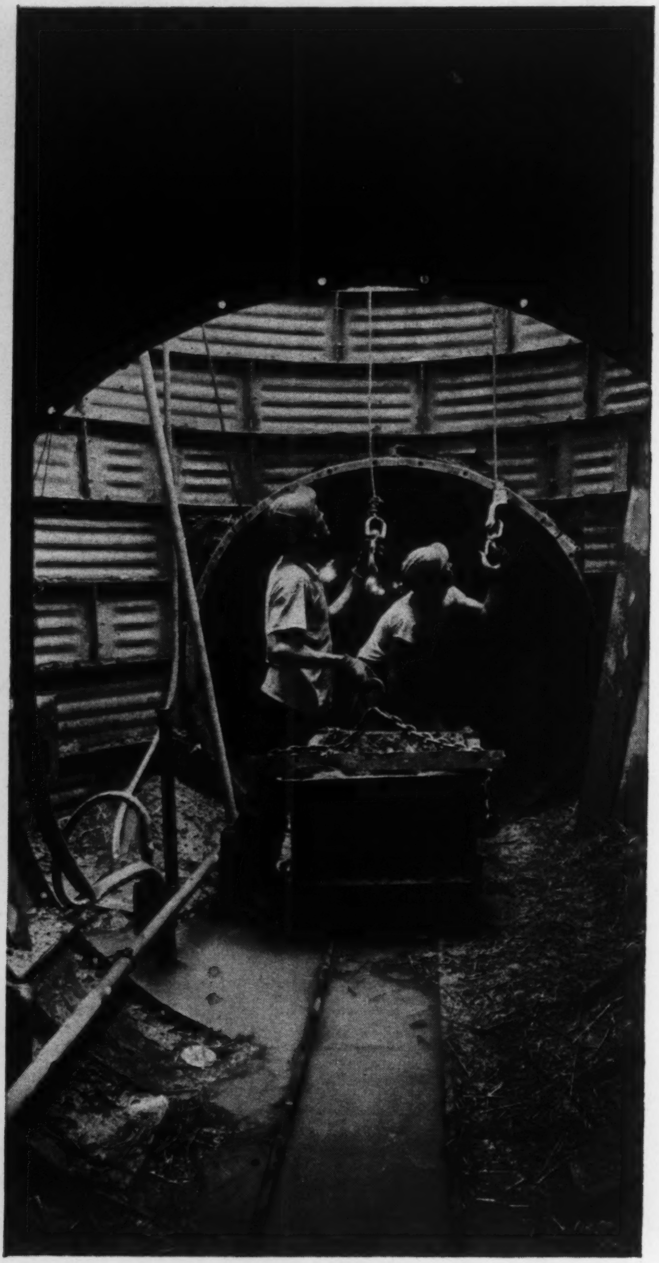
Manufactured by **FIESE & FIRSTENBERGER MFG., Inc.** 2494 Railroad Ave
Fresno, California

New Construction Idea News

Faster, safer tunneling and how it's



COMPLETED IN 3 WORKING DAYS—352 COMMERCIAL tunnel liner plates reinforce 192" diameter, 30 feet deep, initial access shaft for Tousley Construction Co. section of the sewer project. As vertical shaft bored downward, the 16" x 37$\frac{11}{16}$" tunnel liner plates were successively secured in position with ¾" bolts.



UNCLUTTERED WORKING AREA at Thompson Construction Co. access shaft permits easy entry into tunnels and allows fast removal of ⅝ cubic yard mucking bucket loaded with chunks of hard-packed blue clay from tunnel heading. Bucket is lifted and dumped at surface by crane equipped with 35 ft. boom.

being done

Steel liner plates produced by COMMERCIAL for speedier assembly and greater safety factor *prove unanimous choice* of two different contractors on $1,710,000 Indianapolis storm interceptor sewer project.

Contracts for the nearly two miles of tunneling involved in the East Michigan Street storm sewer job at Indianapolis, Indiana were awarded to two separate firms. And here's what they had to say about their independent choice of COMMERCIAL steel tunnel liner supports:

"No other liner plate can compare with COMMERCIAL for easier and faster installation and assembly," says Mr. Porter Williams, Secretary of the Thompson Construction Company. "And among all steel tunnel liner designs, we are firmly convinced there is none safer than COMMERCIAL's," he added.

"We have been using COMMERCIAL tunnel liner plates exclusively for three years," commented Mr. Don Bixler, President of the Tousley Construction Company. "Their consistent size and uniformity simplifies placement and speeds fastening," he continued.

The Thompson Construction Company is handling 5400 feet of the tunnel project—two sections of 48" and 84" in diameter. Both sections are being tunneled simultaneously but in opposite directions through hard-packed blue clay soil. The 84" diameter tube will house a 60" I. D. pre-cast concrete pipe, while the 48" section will enclose a similar 18" pipe. Space between pipe and liner shell will eventually be filled with concrete. In addition, twelve 21 ft. deep vertical shafts, each fitted with manholes for future access, will be dug at strategic points along the complete length of the tunnel.

The Tousley Construction Company, on another contract, is constructing 4500 feet of tunnel, 900 feet of which will be 10 ft. in diameter and the balance of 3600 feet 11 ft. in diameter. Pre-cast concrete pipe 96" and 102" in diameter will eventually line the entire tunnel. Progress on the job, which will also include six 30 ft. deep vertical shafts for future access, is moving along at the rate of 12 feet per day in spite of the hard-packed blue clay and water seepage complications involved.

For more complete details on how COMMERCIAL steel liner plate can simplify and speed up your vertical shaft, surface or sub-surface tunnel project—help make it safer—send today for your copy of Bulletin 300-C2. With over 25 years experience in the design of supports for soft ground or rock excavation, COMMERCIAL's engineers may be able to suggest a more workable and economical solution to your particular support design problem whatever it may be. Address: Commercial Shearing & Stamping Company, Dept. C 40, Youngstown 1, Ohio.

10 FEET PER DAY is average rate of progress in each of the concurrent Thompson tunnels. As fast as mucking operation progresses, 3/16" thick COMMERCIAL liner plates are rapidly installed by the head miners. The size and uniform shape of the plates facilitate their storage alongside mucking car tracks.

NO OUTSIDE BOLTING—Deep flange which surrounds all four sides of COMMERCIAL plate eliminates this hazard. All head miner does is to position plate, line up accurate pre-punched bolt holes, insert ¾" quick acting bolts and tighten nuts with a pin wrench. No fear of loose fit because inside through-flange connections eliminate need of outside support for bolt heads.

NEWS BRIEFS . . .

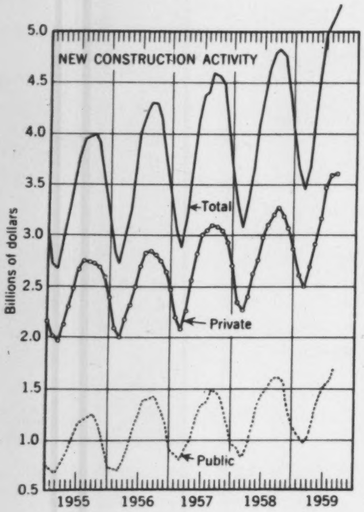
Value of August Construction Rises Slightly

The value of new construction put in place in August amounted to $5.3 billion, according to preliminary estimates of the Bureau of the Census, U. S. Department of Commerce. This represents an increase of 1 percent over July, slightly less than the normal seasonal July-August rise. Construction this August was 13 percent over the August 1958 total.

The total value of work put in place in the first eight months of 1959 is put at $35.7 billion, 15 percent ahead of the same period in 1958. The physical volume of new construction put in place in the first seven months of the current year is estimated to be 13 percent above the volume for the corresponding 1958 period.

Following the normal seasonal pattern, outlays for new private construction in August were $3.6 billion, about the same as in July. For the first eight months of 1959 the total is $24.8 billion, 16 percent above the same period of 1958. With new residential construction showing a small contra-seasonal decline in August to about $2.1 million, the seasonally adjusted annual rate dropped about 3 percent, continuing the decline from the May 1959 peak. However, the August 1959 expenditures for new residential construction are 22 percent above the 1958 level, and expenditures for the first eight months of the year are 31 percent ahead of the first eight months of 1958. Private industrial expenditures are up 2 percent over a year ago, the first over-the-year increase since December 1957.

Expenditures for public construction show a normal rise in August to $1.7 billion. For the first eight months of 1959, the value of work put in place is $10.8 billion, 14 percent above the same period of 1958. Nearly all types of work share in this increase. However, the eight-month total of expenditures for educational building is down 4 percent from 1958.



Dollar value of construction in August represents 1 percent increase over July and 13 percent increase over August 1958.

With few exceptions, these monthly estimates are not based on direct measurements. Primarily, they are derived by applying standard progress patterns (which include assumed normal seasonal factors) to the value of contracts awarded prior to the current month. Except when special surveys are made, the estimates do not reflect the effects of the varying number of working days in different months, or of special conditions influencing the volume of activity in any given month. No special survey has been conducted to measure the effect the current stoppage in steel production may be having on construction activity.

San Jose, Calif., Studies Municipal Airport Expansion

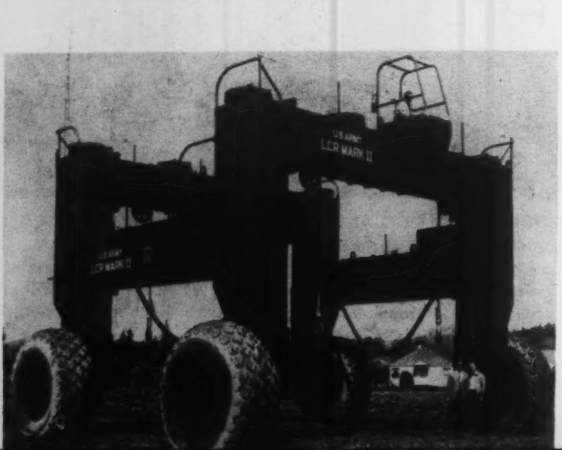
The city of San Jose, Calif., has retained Rader and Associates, engineers and architects of Miami, Fla., to master plan the expansion of the San Jose Municipal Airport and to construct a new terminal building. The contract calls for blueprinting airport development for the next 15 years, plus a detailed study of charges and revenues. It is expected that the master plan will be ready in about four months. San Jose is in the center of a rich fruit-growing region, and industrial expansion in recent years has been rapid.

The FAA National Airport Plan of 1959 recommends early extension of the present 4,500-ft paved runway at San Jose to 5,500 ft, as well as the addition of a parallel runway; widening and extension of taxiways; and a new terminal building to replace the present temporary terminal.

Construction Projects in Foreign Countries Listed

To provide U. S. engineers and business concerns with leads for potential projects abroad, the Bureau of Foreign Commerce of the U. S. Department of Commerce has established a special section in its Foreign Commerce Weekly entitled "Planned Construction Projects." This new feature includes information on all types of planned construction in all parts of the world. The various news items, which are extracted from available releases and reports submitted by U. S. Foreign Service posts, should be helpful to engineering and construction firms and manufacturers of equipment.

Inquiries should be sent to Ernst A. Van Es, Director of the Transportation and Utilities Staff, Bureau of Foreign Commerce, U. S. Department of Commerce, Washington 25, D. C.



Army Develops Landing Craft Retriever

Large enough to permit three lanes of traffic to pass between its legs, the Army's new Mark II Landing Craft Retriever is 25 ft high and 36 ft wide. It is capable of carrying a load about equal to its own weight, which is 70 tons. Power for the craft retriever is provided by two 534-cu in. Ford Industrial engines. Developed by the U. S. Army Transportation Corps Research and Engineering Command, Fort Eustis, Va., the unit is a self-propelled, rubber-tired gantry crane with lifting hooks and salvage pumps designed to retrieve disabled or beached landing craft. It can operate with almost half its structure submerged.

Emergency Work at Earthquake Site Prevented Flood Disaster

The Army's Corps of Engineers again showed its emergency potential in disaster relief when it won a race with a possible flood situation on the Madison River in southwestern Montana. The river was choked by a 43,000,000-cu yd earthquake-triggered mountain slide on August 17. Prompt planning plus mobilization of men and equipment resulted in moving a half-million cubic yards of material to make a rock-lined spillway over the slide by September 9. The spillway is believed to be capable of withstanding 10,000 cfs of flow, adequate for expected runoff.

This natural dam, with its emergency spillway is expected to form the permanent "Slide Memorial Lake." The name commemorates the nine campers known to have died in the valley, and the nineteen others missing since the quake and the slide and believed to be buried in the rocky rubble. The slide has a length of nearly a mile; material piled up to a maximum height of 400 ft.

The slide is seven miles downstream from Hebgen Dam, an earth dam with concrete core wall built in 1915 by a predecessor of the Montana Power Company. This dam was in the area of greatest surface movement and was somewhat damaged by the quake. Settlement of the earth fill of as much as 4 ft occurred on both sides of the core wall. A few cracks, up to 3 in. wide, also appeared. The quake "tipped" the reservoir, sending a series of waves, estimated at from 17 in. to 3 ft in depth, over the top of the dam, but resistance to erosion was surprisingly good. For some time it was expected that the dam might fail, releasing 300,000 acre-ft of water.

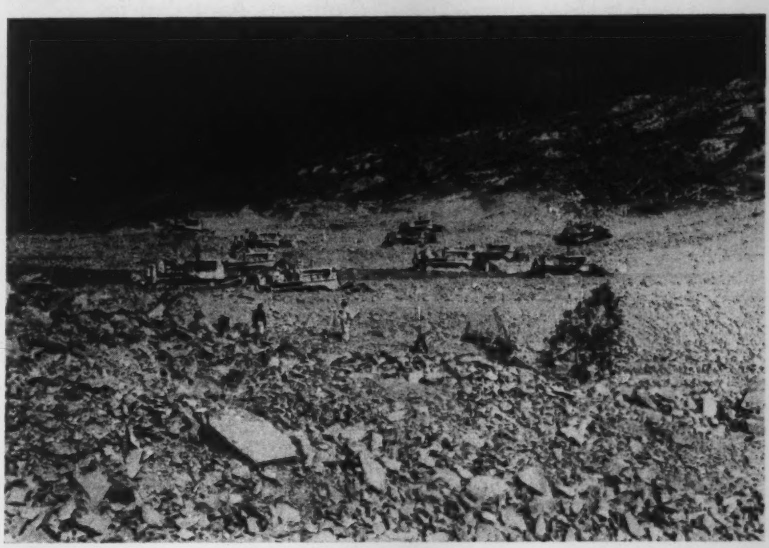
Faced with the possibility of Hebgen Dam's failing, the Corps of Engineers saw the necessity of emergency action to assess the flood problem and alleviate it. Maj. Gen. Keith R. Barney, F.ASCE, Missouri River Division Engineer, after phone conferences with the Office of the Chief of Engineers, flew to the quake scene from his headquarters at Omaha, Nebr., for a personal survey. After two days of investigation, General Barney ordered his Garrison District Engineer, Lt. Col. Walter W. Hogrefe, to rally a team of engineers, technicians, and contractors for flood emergency service.

Colonel Hogrefe, with H. F. Michel, M.ASCE, as chief of party, set up a field office at West Yellowstone on August 23, staffed with about 50 district people. Meanwhile engineers, geologists, and consultants had decided that the most efficient, yet speedy, method of meeting a possible flood emergency would be to build a rock-lined spillway with material at hand—a spillway as wide and as flat as possible to carry water across the barrier.

Colonel Hogrefe immediately mobilized dozers, shovels, trucks and other heavy equipment. This was done in three days with the assistance of Jack Marlow of Helena, Mont., manager of the Montana Contractors Association, and Chat Oliver of Billings, Mont., an associate of the Long Construction Company. They invoked AGC's "Plan Bulldozer," and by the time the 22-hour-a-day surge was over on September 9 there were 52 pieces of equipment and 104 operators in the cut. As the water came over on September 9, the Corps had ready for it a flow-way lined with from 7 to 10 ft of large rock and capable of carrying 10,000 cfs. To keep velocities in the spillway as low as possible, a width of 250 ft was adopted.

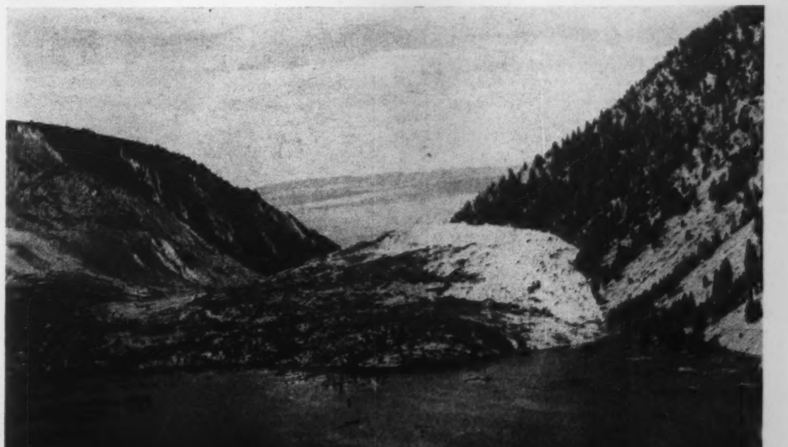
The position of the spillway—the lowest portion of the slide mass—was chosen by the consultants because of the favorable distribution of materials. They believed the slide would act as a stable natural dam, and it is holding satisfactorily. A drilling crew is making borings to determine exactly the composition of the slide mass.

Before the earthquake, the south wall



Eight Montana contractors rushed men and machines to fight the threatened flood that followed Yellowstone Park earthquake. Here U. S. Army engineers direct the work of a fleet of heavy earthmovers in building a 250-ft-wide spillway along the top of the slide. In addition to the spillway work, the 23 crawler tractors on the job leveled the crest of the slide for 1,000 ft.

When an earthquake struck western Montana on August 17, 43,000,000 cu yd of rock thundered across the Madison River canyon, 7 miles below Hebgen Dam. In a crash program of flood protection for residents of the Madison Valley, Corps of Engineers experts rushed excavation of a spillway to control the cresting waters. Slide area is shown between the two mountains.



of Madison Canyon was very steep, apparently supported by a buttress of outcropping quartzite and dolomite, which in turn was underlain by schist and gneiss. The supporting buttress was buckled by the earthquake and slid out on a weathered, decomposed schist. A secondary slide moved off the upstream end of the initial slide area, creating a terrace of disintegrated schist on the upstream face of the natural dam. Considering the predominance of quartzite and dolomite, particularly in the downstream portion of the slide mass, the high degree of compaction, and the constriction of the downstream toe of the slide by the canyon walls, it was concluded that the natural dam would be stable and would not experience any serious movement.

In profile, the material in the saddle, as exposed on the surface, is graded from massive quartzite blocks at the downstream toe, through schist and gneiss in the central portion, to weathered gneiss and schist, with the voids almost completely filled with fine-grained non-plastic soil, at the upstream toe. The slide mass has roughly the characteristics of a composite earth and rockfill dam, with the relatively impervious material upstream. The downstream toe is very flat, with a slope estimated at about 1 on 12. The upstream slope is estimated to be about 1 on 7. The base width is from five to eight times as great as would have been used in building a rockfill dam of the same height. Considering the apparent gradation of the materials in the mass, it seemed probable that seepage water might flow over the upstream impervious mass as over a control weir, then drop sharply and saturate only the lower levels of the downstream portion. To avoid concentration of flow that might cause scouring, the spillway was designed to spread the flow in a thin sheet of as nearly uniform depth as practicable.

The Corps was directed by Congress to take emergency action following a request to Washington by Gov. J. Hugo Aronson, of Montana.

["Civil Engineering" is indebted for this story of the Corps of Engineers' emergency action at the reservoir site to Jack Bailey, Technical Liaison Branch, Garrison District, Corps of Engineers.]

Contracts Awarded for Chesapeake Bay Project

To motorists who have waited in line—sometimes all day—for the Chesapeake Bay Ferry connecting the Virginia mainland with its Eastern shore, it will be very good news that a construction contract has been awarded for the long-discussed bridge-tunnel project across Chesapeake Bay.

Four contracting firms have received the $126 million contract from the Chesapeake Bay Ferry Commission for the construction of the 17.5-mile bridge-tunnel project. The joint-venture group consists of the Tidewater Construction Corp., of Norfolk; Merritt-Chapman & Scott; Raymond International Inc.; and Peter Kiewit and Sons, Co. A $2,000,000 plus contract has also been signed with the American Bridge Division of U. S. Steel for furnishing and erecting steel for bridges across North Channel and Fisherman Inlet. Sverdrup and Parcel have a $7.6 million contract for engineering services.

The project will consist of a trestle-type bridge with prestressed concrete members and two trench-type tunnels, each of them about 6,000 ft long. About 7,000,000 cu yd of material will be required to make the four artificial islands for the tunnel entrances. A large restaurant and two fishing piers will be built on one of the islands.

Steel Topped Out for Chase Manhattan Bank

The heaviest and tallest steel frame for any building erected in the past 25 years was topped out on September 9, when Bethlehem Steel Company ironworkers raised a 47-ft column section into position for the new $131,000,000 head office building of the Chase Manhattan Bank in lower Manhattan. The 53,000 tons of fabricated structural steel used in the new building are probably exceeded only by the RCA Building's 58,500 tons and the Empire State Building's 58,000 tons. In fourth place, with 51,400 tons, is Chicago's Merchandise Mart.

Guests and newsmen attending the ceremonies observed proceedings through what is believed to be the first closed-circuit televising ever attempted of a topping-out ceremony. The picture, showing an American flag attached to the topping-out piece, was beamed via closed circuit to a lower floor location eliminating the need for climbing many flights of stairs. The 60-story building rises more than 800 ft above street level and will be the sixth tallest skyscraper in the world.

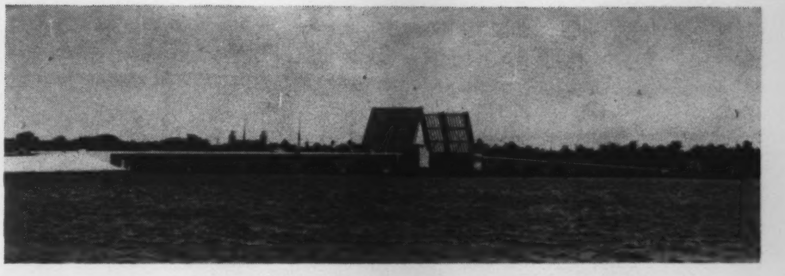
The building, to bear the address No. 1 Chase Manhattan Plaza, is located on a 2½-acre two-block site bounded by Nassau, Liberty, William and Pine Streets. Upon completion next summer, it will have a south plaza measuring 120 by 210 ft and requiring an additional 1,730 tons of fabricated structural steel. It will be covered with an exterior of aluminum and glass. The gross floor area will be 2,300,000 sq ft.

Steel was fabricated at Bethlehem's Pottstown, Pa., works. The 40 columns supporting the main core are among the heaviest ever fabricated. Each will carry loads up to 7,900 tons—heavier than the Empire State's 5,100 tons. They were shipped to New York in sections up to 36 ft in length, and weighing as much as 52 tons. Field connections were made by high-strength bolts. Ground for the project was broken January 28, 1957, and the first grillage, which serves as a column base, was set September 17, 1958.

General contractor for the building is the Turner Construction Company, and the architect is Skidmore, Owings & Merrill. Others connected with the construction phase are Moran, Proctor, Mueser & Rutledge, the substructure consulting engineer, and Weiskopf & Pickworth, the superstructure consulting engineer. The foundation contractors are the Foundation Co., George M. Brewster & Son, and Joseph Miele Construction Co., Inc.

Construction of Priest Rapids Dam Ahead of Schedule

At the end of its third year of construction Priest Rapids Dam, on the Columbia River in Oregon, is about 80 percent completed—sixteen months ahead of schedule. The project is being built for the Grant County Public Utility District by the Merritt-Chapman & Scott Corporation under a $98,000,000 contract. This aerial view shows work in progress on the 22 spillway sections and 1,025-ft-long powerhouse. The latter will house ten generators capable of producing 788,500 kw—enough electrical power to meet the needs of a city of over 2,000,000. Fish passage facilities are being built into the dam on both sides of the river.



New Lift Span Replaces Palm Beach Bridge

Completion of the new Royal Park Bridge between Palm Beach and West Palm Beach, Fla., will be a boon to traffic between the two resorts. The new bridge, which carries four traffic lanes and features a fast-operating lift span, replaces a structure that had been in service since 1924. The original bridge had a 174-ft-long deck-girder swing span, which was so slow in opening and closing that it was necessary to restrict its opening when water traffic was heavy. The swing span has been replaced by a rolling lift bascule span, which is speedy in operation and provides a 90-ft clear channel. The new bridge decking consists of Greulich 4-Way Grid, a lightweight but strong open steel design made by the Kerrigan Iron Works Co. Hazelet and Erdal, of Louisville, were the engineers, and the Cleary Brothers Construction Co., of West Palm Beach, the general contractors. The Nashville Bridge Company fabricated the lift span.

Israel to Have New Mediterranean Port

The Israeli Ministry of Transport and Communications has signed a million-dollar contract with the New York City consulting firm of Frederic R. Harris, Inc., for the detailed design of a new deep-water port at Ashdod on the Mediterranean coast of Israel. The firm has already prepared a master plan for the development of the port, which will be Israel's largest except for Haifa.

The new port of Ashdod is being designed for a straight stretch of coast. Its offshore facilities will be protected from winds and storms by rubble-mound breakwater. The projected finger-type pier system will permit the berthing of from 18 to 22 ships when the first phase of the project is completed and of some 35 ships when the final development phase is completed. It is expected that the port will have an annual handling capacity of 3,000,000 tons of cargo when it is finished. Citrus products, potash, and phosphates will be the principal exports, and grain the major import.

Plans for the port were based on a preliminary beach study conducted by the Laboratoire Central d'Hydraulique de France. Andrew S. Kahan, M. ASCE, assistant engineering adviser to the ministry of Transport and Communications, will be resident engineer on the port development.

Symposium on Plasticity

Brown University will be host to the Second Symposium on Naval Structural Mechanics, to be held April 5-7, 1960, under the joint sponsorship of the Office of Naval Research, Department of the Navy, and of Brown University. The symposium will be devoted exclusively to plasticity, with the program consisting of critical surveys in selected areas and of reports on original research.

The organizing committee consists of Professors E. H. Lee and P. S. Symonds, co-chairmen, and Professors D. C. Drucker and W. Prager. Inquiries should be sent to Prof. P. S. Symonds, Chairman, Division of Engineering, Brown University, Providence 12, R. I.

Radiation Shelters Are Built Into New Homes

For the first time in construction history in the United States, fallout shelters are being built into new homes. A western contractor, in constructing some forty homes in a suburb of Denver, is building in each one a 10 x 13-ft reinforced concrete shelter. The homes are priced at about $17,500.

Considered to be blast and radiation resistant as well as fireproof, the shelters are not an optional feature but rather a regular part of the new houses which the purchaser must accept. Costing about $300 to construct, the shelters can serve an every-day purpose as a dark room, play area, work shop, or storage room.

The shelter, located under the garage of the house, is a windowless room and opens off the basement with the same headroom as the basement. With reinforced concrete walls 8 in. thick and a ceiling that is a foot thick, the shelter features electrical outlets, air vent pipes, a 40-gal cold water storage tank, a chemical toilet, and a radio aerial.

Jack C. Hoerner, the pioneer contractor, states that the construction of the shelter was accomplished by use of the same principles and techniques normally employed in building a standard basement wall. For the overhead ceiling, he followed the same methods used in commercial floor construction.

New Highway Connects Norway and Sweden

A new 22-mile international highway connecting Norway and Sweden was officially opened this July. The road, which is 19 ft wide, runs through Storlien, Sweden, and provides a connection between road networks that formerly ended at the highway's two terminal cities—Koppera, Norway, and Enafors, Sweden. Replacing an old mountain road that is closed to automobile traffic in the winter, the new highway provides a more direct route from the Gulf of Bothnia coast of Sweden to Trondheim Fjord in Norway.

With an oil harbor under construction at Trondheim Fjord, the international highway will speed the flow of petroleum products into Sweden.

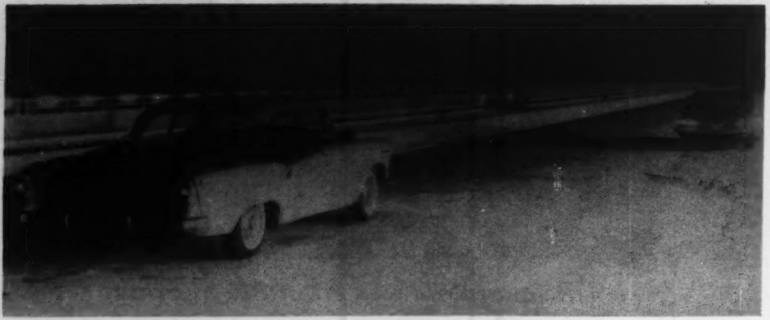
Placing Reinforcing

Recommended Practice for Placing Reinforcing Bars is a completely new handbook prepared under the direction of the Engineering Practice Committee of the Concrete Reinforcing Steel Institute by R. C. Reese, F.ASCE, consulting engineer of Toledo. The manual summarizes the best of accepted current practices in the placement of reinforcing bars, welded wire fabric and their supports in reinforced concrete structures. The book will be most helpful to field engineers as it gives in simple language with excellent illustrations details of how steel should be placed, supported, tied, and the like. Permissible tolerances are given with reasons for accuracy so that the importance can be explained to the field forces.

A glossary of terms and simple sketches showing names of various components of construction will help those new to field work to an immediate understanding of construction job jargon.

The book is recommended equally for detailers. It is an excellent guide for the young and a good review of the best current practice for the more experienced. It is a usable aid for teachers and students, as it contains much information not usually found in textbooks.

The handbook is available at $3 a copy from the Concrete Reinforcing Steel Institute, 38 South Dearborn Street, Chicago 3, Ill.



Aluminum Bridge Railings Used for Bridge Lighting

A unique new type of aluminum bridge railing that serves as a "continuous lamp post" has been unveiled by the New Jersey State Highway Department on the Route 72 Manahawkin Bay Bridge. The 4,800-ft bridge railing has luminaires spaced 2 ft apart along the top rail to give the lighting effect shown here. The railings are mounted on a parapet that brings their overall height to 50 in. Fluorescent luminaires 42 in. long are recessed into cut-out sections of the top rail, which is elliptical in shape. The luminaires are mounted so that all light is directed at the roadway, providing even illumination of its entire surface. The railings were extruded and fabricated by the Michael Flynn Manufacturing Co., of Philadelphia, to meet State Highway Department specifications. The lights were designed and supplied by General Electric.

EXAM GEMS

by

Reggie Strashn

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 3, as given last February in Ohio, displayed the trapezoidal section (Fig. 1 (*a*)) of a dam originally impounding water to a depth of 40 ft, of which 25 ft was now silted. An illustrated comparison of before-and-after pressure intensities was required. The pitfalls of this recent test were discovered by asking several California EITs to solve it.

They agreed well on the original conditions. The horizontal pressure varied with the depth, $p = wy$, defining a triangular pressure diagram with an intensity of $62.5 \times 40 = 2{,}500$ psf at the heel. Uplift was overlooked by some, but shown by two with half the horizontal intensity at the heel and varying uniformly to zero at the toe. This answer conforms to the common but controversial hypothesis that pore pressure in the foundation is measured from a hydraulic grade line joining headwater and tailwater surfaces and representing friction loss of seepage, with the convenient presumption that the dam rests half on pores and half on solids.

Turning to present conditions, most of the EITs wasted time looking for a formula to compute the wet density of the silt from the 2.65 given as specific gravity of solids and the 0.80 given as the void ratio. Fifth-grade arithmetic works faster than finding and fooling with fancy formulas. For each cubic foot of solids weighing 2.65×62.5 lb there is water-filled void to 0.8 cu ft weighing 0.8×62.5, making a total of 1.8 cu ft weighing $3.45 \times 62.5 = 216$ lb. Hence the wet density is

$$d = W/V = 216/1.8 = 120 \text{ pcf}$$

Altho all the EITs ultimately found this density, they didn't agree on how to use it. The wet silt was described as cohesionless and having a zero angle of internal friction, hence as watery as water but heavier. Pressures, whether active or passive, vertical or horizontal, are measured by the overburden. At *B*, this is $15 \times 62.5 = 937$; at *C* there is added $25 \times 120 = 3{,}000$ to make 3,937 (Fig. 1 (*b*)).

All those who strayed on this last step made the simple problem harder by using the factor $k = 0.3$ common to working formulas for earth pressure on retaining walls, generally finding less pressure from the wet silt than from the original load of water. The exception visualized the silt-water complex as a lattice and added hydrostatic pressure for the pore contact to earth pressure for the solids contact for a pressure of 3,012 psf at the heel!

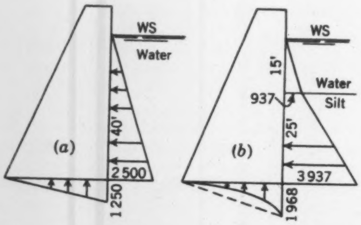


Fig. 1. Unit pressure in psf before (a) and after (b) deposit of silt behind gravity dam, with two ideas on uplift.

The two bright EITs who considered uplift were bright enuf to find 3,937 psf at the heel. One of them jumped to the fallacious conclusion that the hydraulic grade line for seepage would be upped in the same proportion, so he showed uplift varying uniformly from 1,968 psf at the heel to zero at the toe (dotted line).

The other admitted uncertainty. The steeper grade line would mean more seepage or less permeability. If more seepage, it would be water flowing from *B* or fluid silt from *C*. The first would increase length of seepage path without increase of head, slightly reducing uplift from original conditions. The other would tend to seal the pores and reduce permeability, progressively from heel to toe. He chose the latter and drew a parabolic uplift pressure diagram (full line).

Summarizing the pitfalls: (1) many overlooked uplift, (2) most wasted time hunting a formula for an elementary task, (3) some couldn't grasp the fictitious fluidity specified for the silt, and (4) few could rationalize the underflow-uplift relation. For uplift, authorities do not agree on a right answer, so any reasoned answer is creditable, but to overlook uplift is indefensible.

EXAMGEM No. 4

The most important difference between civil and military engineering is the application of engineering economics. Registration examinations frequently test the applicants' grasp of economic principles, but usually with academic problems. Here is an unusual one, given in Idaho in March 1957, for which some data must be supplied from the experience or ingenuity of the prospective registrant. The cost of installing various sizes of ordinary cast iron pipe is given below:

PIPE SIZE	COST PER FT
2 in.	$0.72
2 ½ in.	1.02
3 in.	1.42
4 in.	2.05
5 in.	2.50

In the system planned the pump is to deliver 120 gpm, the discharge pipe length is 1,000 ft, the overall efficiency of pump and motor is 75 percent, and the pump is to operate 10 hr per day for 300 days per year. It is estimated that 13 percent of the pipe cost may be taken as the annual cost for interest, depreciation, and maintenance. The cost of electric power is one cent per kwhr.

Make a comparative cost study and recommend the most economical pipe size for this system.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

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Optical Plummet solves problem on Niagara Power Project

Frank Dickey (r.) checks Gurley Optical Plummet Transit on Niagara Power Project job.

"Sometimes a seemingly little thing can make a big job easy," says Frank Dickey, Project Engineer on the Niagara Power Project for Channel Constructors—a joint venture of Peter Kiewit Sons' Co., Morrison-Knudsen Co., Perini Corp., and Walsh Construction Co.

"We had an unusual problem here on excavations for the 500-foot-wide channel which will handle the water for the new Niagara hydroelectric plant. The conduits will pick up water from the Niagara River a couple of miles above the Falls and carry it underground through the city to an open channel, reservoir and 2,190,000-kilowatt power plant located several miles down the river.

"The channel had to be cut from dolomite. We decided to line drill the full 105-foot depth at one time, using 6-inch diameter holes on 5-foot centers. It was our intent to line drill the entire job, some 1600 holes, before any of the excavation was finished to grade. This made it necessary to devise a method of checking the holes for plumb from the surface so as to be sure that they did not deviate enough to get outside the tolerance allowed by the specifications.

"We thought of several ways to do this but none very practical, until one of the men mentioned having used a Gurley Optical Plummet Transit on another kind of job up in Canada. We decided to try the 'bobless transit' here.

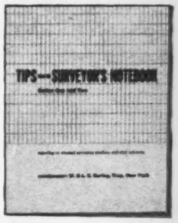
"We set up over the opening; then leveled the instrument with the North plate bubble over two opposing leveling screws. Then we sighted in the Optical Plummet and started moving the other two opposing leveling screws until we were able to pick up the light—by means of the 'OP'—from a dime store flashlight which had been lowered into the hole by a string.

"While moving the two opposite screws, we constantly checked the North plate vial to make sure that it remained level throughout the movement. After we picked up the light from down the hole, we moved the telescope until its bubble was in the center. When this was established, we read the vertical circle—this giving us the angle at which the hole had been drilled.

"This proved to be accurate and a fast system for checking the holes and undoubtedly gave us a better job than we could have otherwise obtained.

"This use of the 'OP' is a special case," Mr. Dickey added. "But I'll bet there will be many other jobs that the 'OP' can lick. For years I cussed the plumb bob, especially when the wind was blowing...always wished someone would do something about it."

You, too, can do something about the plumb bob problem. Gurley *built-in* optical plummets eliminate outmoded bobs...save set-up time...improve accuracy. *Bulletin OP-100 gives complete details on two models available.*



***"Tips from The Surveyor's Notebook"**: We have collected the most helpful, most discussed pages from Series One and Two of "The Surveyor's Notebook" in one 20-page book. These valuable field suggestions will help you use your own instruments with greater success. Write for your free copy.*

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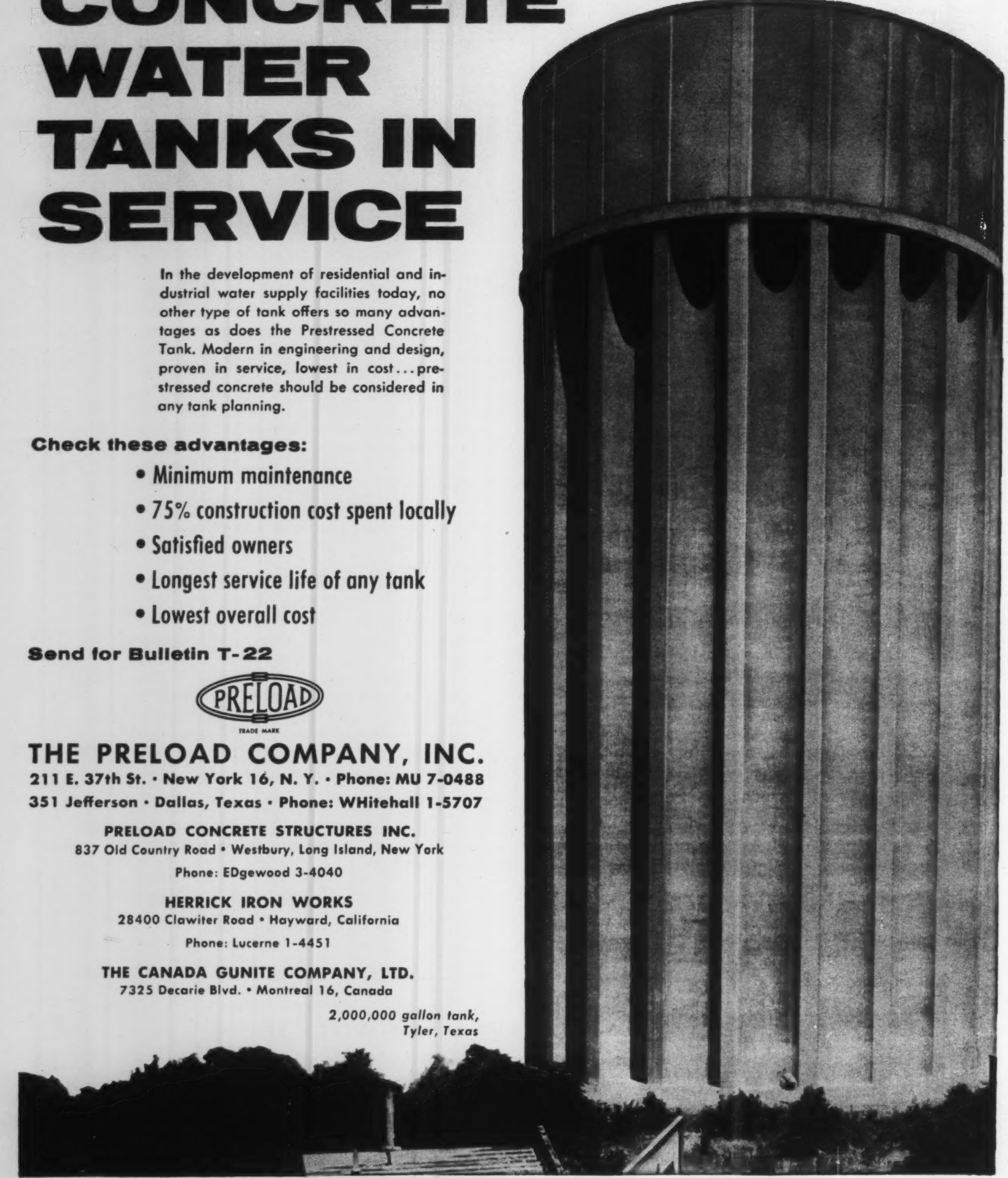
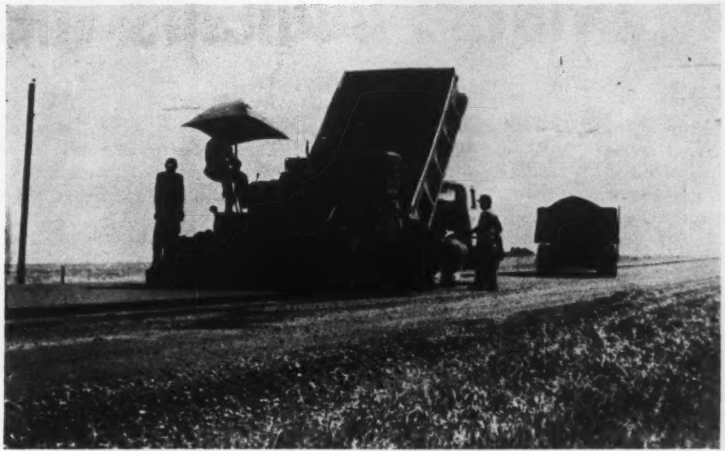
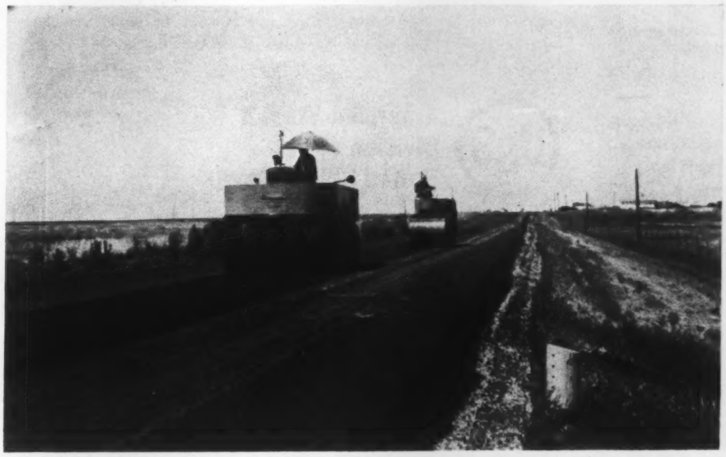


2,000,000 gallon tank, Tyler, Texas

South Dakota can employ stage construction on highways . . . with ASPHALT



Second step in stage construction on U.S. Route 212 in South Dakota. Laying plant-mixed Texaco Asphaltic Concrete over old Road-mixed asphalt pavement.



Type of rollers used to assure satisfactory compaction of new Texaco Asphaltic Concrete wearing surface.

An important advantage of asphalt to highway officials is that it lends itself so well to long range stage construction. South Dakota demonstrates this on the 9-mile section of U.S. Route 212 illustrated here.

Some time ago, the state constructed a relatively low cost type of asphalt surface on this highway by the Roadmix method. After it had served traffic for a number of years and had become thoroughly consolidated, the highway was ready for the second stage. A high-type plant-mixed Texaco Asphaltic Concrete pavement was laid this year over the original Road-mixed asphalt surface. The new and the old asphalt courses combine to form a rugged pavement which will serve the highway's increased traffic for many more years, with a minimum of maintenance.

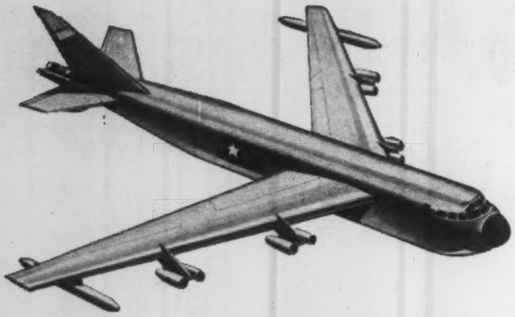
Stage construction of highways with asphalt enables South Dakota to spread the cost over the years, while giving traffic a durable, all-weather pavement at all times.

Helpful information on Road-mixed and Plant-mixed asphalt paving is supplied in a pair of free Texaco brochures. Copies of these can be had by writing our nearest office. No obligation.

Contractor
HAGGART CONSTRUCTION CO.
Fargo, S.D.

TEXACO INC., Asphalt Sales Div., 135 E. 42nd Street, New York City 17
Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 1 • Minneapolis 3 • Philadelphia 2 • Richmond 11

TEXACO ASPHALT



At Kinross Air Force Base...

helps the

THE "JET AGE" IS HERE. And with it is the problem of rebuilding airports to provide the longer, stronger, heavier runways these big jets need. That's why airport builders and designers are planning thicker, stronger airfield pavements with extra-heavy reinforcement . . . pavements that will match or exceed present jet requirements. And that's why the heaviest welded wire fabric ever produced was installed at the vital Kinross Air Force Base in Michigan.

Operational jets in commercial service now impose gear loadings in the neighborhood of 130,000 lbs., with gross weights of 295,000 lbs. Future models may go even higher. For that reason, only reinforced concrete provides the added strength to meet the unusually heavy and severe requirements of the "jet age." Specify USS American Welded Wire Fabric for reinforcing all runways, high speed turnoffs, taxiways, and service pads . . . get these important advantages:

- USS American Welded Wire Fabric distributes heavy wheel loadings over a larger area to prevent harmful overloads at any one point. Impact, shock, suddenly applied or released loads such as occur during landings and take-offs are more uniformly "absorbed" by each slab. Reinforced concrete slabs are 30% stronger than unreinforced slabs of equal thickness.
- USS American Welded Wire Fabric prevents harmful cracking from developing because of its uniformly spaced high-tensile-strength welded steel wire construction. Its action "knits" a slab together.
- USS American Welded Wire Fabric unifies the action of any slab when it expands and contracts due to temperature change.
- Longer, wider slabs can be laid when USS American Welded Wire Fabric is used. This means fewer joints, fewer load transfer assemblies. The reduction in the number of joints not only means economy, but also a smoother, safer landing surface.
- When existing airfield pavements must be strengthened, USS American Welded Wire Fabric reinforced concrete overlays will produce unbroken grade lines and provide additional strength. Thus, maximum economy is achieved.

Specify USS American Welded Wire Fabric. It's available in a wide variety of styles, lengths, and widths . . . in wire sizes from ½" diameter to 16 ga. and in longitudinal or transverse wire intervals of 2" to 16". The engineers at American Steel & Wire will be glad to tell you more about the application possibilities of fabric and how it can serve your needs. Get in touch with American Steel & Wire, Dept. 9302, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

USS and American are registered trademarks

Contractor: Loselle Construction, Inc., Wyandotte, Michigan
Paving Material Supplier: Scioto Supply Company, Lansing, Michigan
Design and Supervision: Corps of Engineers, U. S. Army

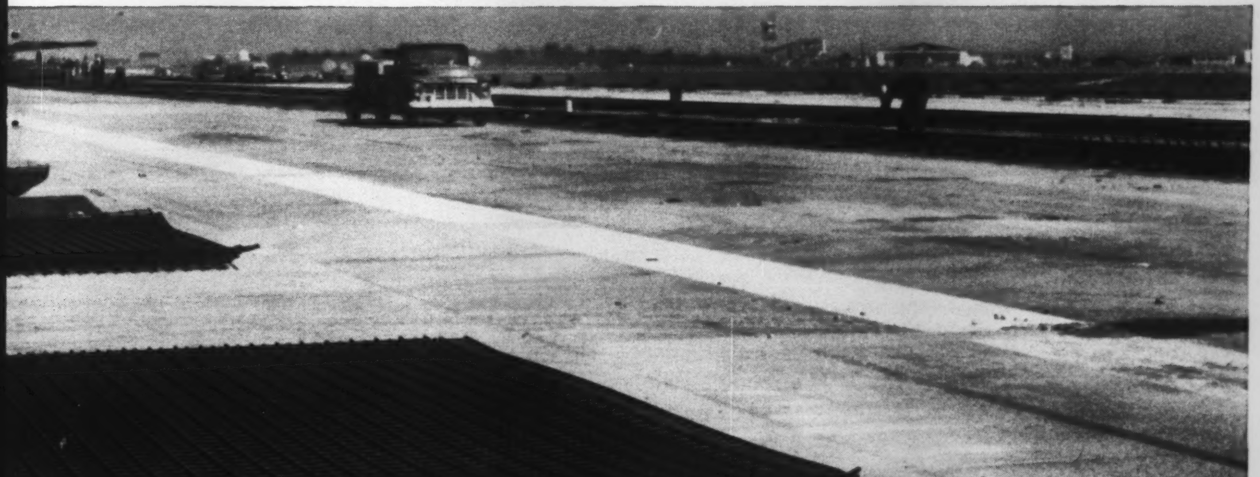
USS

American Steel & Wire
Division of
United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

At Kinross Air Force Base, workmen are installing a section of USS American Welded Wire Fabric—Style 55-7/07/0 (7/0 Gauge is 0.490" Diameter Wires). USS American Welded Wire Fabric is entirely fabricated by electrically welding all intersections of the high strength steel wires. This insures positive placement of the steel in the slab and eliminates costly field tying and extra handling.

World's heaviest Welded Wire Fabric big jets land safely!



Under the direction of the U. S. Corps of Engineers, another new United States Air Force Base is made ready to join our air defense network. It is Kinross, located on the Upper Peninsula of Michigan. This base was expanded to handle bigger, heavier modern jet aircraft. USS American Welded Wire Fabric was used in the rigid overlays on the strengthened and lengthened runways.

USS American Welded Wire Fabric

DECEASED

T. Warren Allen (M. '14; F. '59), age 94, a veteran in road design and construction, died in Washington, D. C., on August 10. An 1886 graduate of Union College, he was a civil engineer with the Bureau of Public Roads from 1913 to 1937. During this period he served as superintendent of public works for Puerto Rico and did much in planning the road system in Hawaii, remaining there for several years after leaving the Bureau. Mr. Allen was author of many articles on highway construction and trained many young engineers in modern road building.

David Reeves Arnold (A.M. '26; M. '59), age 70, for many years designer and builder of bridges for the Cleveland Union Terminal Company and the New York Central Railroad, died in Wellington, Ohio, on July 23. After retiring as a bridge engineer for the New York Central Railroad in 1954, Mr. Arnold was associated with Arthur G. McKee and Company of Cleveland, Ohio, as structural engineer. Mr. Arnold graduated from Case Institute of Technology (then Case School of Applied Science) in 1911.

Clifton T. Barker (A.M. '35), age 61, retired chief of the Tennessee Valley Authority's River Transportation Division, at Knoxville, died there recently. After retiring as chief in 1946, Mr. Barker continued with the Authority until his death as a full-time waterway transportation specialist. Mr. Barker became connected with the TVA at its inception in 1933, after a decade of work with the Corps of Engineers for which he had made navigation studies of the Tennessee River basin and the Missouri River and its tributaries. Mr. Barker was a graduate of the University of Minnesota.

Wallace E. Belcher (M. '13; F. '59), age 79, consulting engineer, of Philadelphia, Pa., died in Philadelphia on August 23. Mr. Belcher, who was graduated from the University of Maine in 1899, had been associated with engineering firms in Boston, New York and Philadelphia. In 1929, he joined the United Engineers and Constructors, Inc., of Philadelphia, where he remained until 1955.

Bernard S. Bush (A.M. '44; F. '59), age 59, since 1940 regional sanitary engineer for the Pennsylvania Department of Health, died at Wilkes-Barre, Pa., on August 4. Mr. Bush had been associated with the Department since 1927. Following the devastating floods in the wake of 1955's Hurricane Diane, Mr. Bush directed much of the work of rehabilitating public water supplies. In 1954 he received the "Arthur Sidney Bedell Award" of the Federation of Sewage and Industrial Wastes Associations for "outstanding personal service" to the Federation's Pennsylvania Branch of which he had been secretary-treasurer for fifteen years. Mr. Bush graduated from Pennsylvania State University in 1924 with a B.S. in mechanical engineering.

Ray Cavendish (M. '41; F. '59), age 59, former state road commissioner for West Virginia and chief engineer of the West Virginia Turnpike, died recently in Portland, Me. Mr. Cavendish resigned from the Turnpike Commission in 1954 to join the engineering firm of Fay, Spofford and Thorndike, for whom he was project engineer in Portland.

Marvin Chase (M. 07; F. '59), age 96, retired hydraulic engineer and pioneer Western builder, died in Seattle, Wash., on July 23. Mr. Chase's early projects included the Highline Canal, which made possible the famous Wenatchee Valley apple industry, and the Billings (Mont.) Land and Irrigation Company canal, considered one of the most successful of Montana irrigation districts. After serving as chairman of the Washington State Water Code Commission, which drafted the state water code of 1917, he was appointed as the first state hydraulic engineer, a job he held for eight years. In 1919 Mr. Chase was chairman of the Columbia Basin Commission, which performed the initial engineering work for the irrigation of about a million acres of land in the Columbia River Valley. He was also a member of the Columbia River Board, representing the state.

Richard William Dilg (A.M. '57; M. '59), age 33, manager of Real Estate and Construction Services, Canadian General Electric Company, Ltd., died in Toronto, Canada, on August 1. For three years he was resident engineer with the General Electric Real Estate and Construction Services at Schenectady, N. Y., transferring in 1956 to the firm's Canadian affiliate as resident engineer and, more recently, as manager. Mr. Dilg was a 1950 civil engineering graduate of Syracuse University.

Charles E. Fraser (M. '08; F. '59), age 86, retired president and a founder of Fraser, Brace and Company, of New York, and Fraser-Brace Engineering Company, Ltd., of Montreal, Canada, died in Summit, N. J., on August 24. Mr. Fraser was graduated from McGill University (Canada) in 1899. When he was only twenty-nine, he had charge of completing one of the early sections of the I.R.T. East Side subway between 14th and 42nd Streets. Later he superintended the construction of the Manhattan side of the Pennsylvania Railroad tunnels under the East River. With his partner, the late Maj. James H. Brace, he was responsible for the construction of numerous hydroelectric power plants in Canada and the United States and for the Federal shipyard ways at Kearny, N. J., and the Weldon Springs Ordnance Works at Weldon Springs, Mo.

Leo M. Geraghty (M. '31; F. '59), age 66, a project engineer for Lockwood Greene Engineers, Inc., of New York, died there on August 16. Early in his career Mr. Geraghty had been employed as company engineer for Columbia Mills, Inc. He attended the University of Massachusetts.

Howard Whipple Green (M. '33; F. '59), age 66, for many years a leading statistician in Cleveland, Ohio, died there recently. The statistical expert, sometimes described as a population engineer, was an expert on the population trends of the area and related subjects. He had been director of the Real Property Inventory of Metropolitan Cleveland since 1932 and secretary of the Cleveland Health Council since 1925. As senior partner in Howard Whipple Green, Ober & Associates, he worked as consultant on projects involving locations of businesses, wage and hour disputes, fare structures and marketing problems. Mr. Green received a bachelor of arts degree from Clark University in 1914 and the bachelor of science degree in sanitary engineering from both Massachusetts Institute of Technology and Harvard University in 1916.

Hector Griswold (M. '47; F. '59), age 62, a consulting engineer with J. Rich Steers, Inc., of New York, died in Summit, N. J., on August 31. Mr. Griswold received a civil engineering degree from Rensselaer Polytechnic Institute in 1915. He was commissioned in the Civil Engineer Corps of the Navy and served in World War I. He then had an engineering practice. In 1940 Mr. Griswold, who had remained in the Naval Reserve, was recalled to active duty with responsibility for construction projects in the New York Naval Shipyard in Brooklyn. Later he was West Coast representative of the Army-Navy Petroleum Board. In 1947 he retired from the Naval Reserve with the rank of captain and joined the Steers firm.

Albert E. S. Hall (M. '42; F. '59), age 77, a retired civil engineering consultant for the Du Pont Company, died in Ridgewood, N. J., on August 4. Mr. Hall retired as consultant for the design division of the company's engineering department in 1947. He had been with the company since 1918, primarily in design and site selection work, including the Wilmington (Del.) Public Library and the Wilmington Marine Terminal. In 1940 he became active in defense construction and was named principal architect and civil engineer for the company on the design of the Hanford Works.

H. C. Jessen (M. '50), age 68, manager of the Salt Lake City (Utah) branch sales office of the Sika Chemical Corp., died recently in Laramie, Wyo. Mr. Jessen joined Sika in 1953 after a long engineering career with federal and state governments. He had been city engineer of Salt Lake City; commissioner of the Utah Lake and Jordan River Irrigation Commission; supervising engineer of federal works for Utah, Wyoming, Colorado,

(Continued on page 112)

1. Shown here is a prestressed concrete pile that was driven to just above ground and an additional section spliced on. A horizontal load was applied to the top of the new section in a manner that created maximum moment at the splice. Failure occurred not at the splice but below it.

2. Workman is shown lining up pile to be spliced onto one already driven into ground. Note metal jig around top of driven pile with side vents for pouring quick-setting Florok's plasticized cement. Everything needed is at job site.

3. After addition has been set in place and properly aligned, heated Florok's cement (it melts to a light fluid consistency between 265 F and 290 F) is poured into side vents of metal jig. In fifteen minutes jig can be removed and work resumed.

QUICK SPLICING NOW ADDS TO THE ADVANTAGES OF PRESTRESSED CONCRETE PILES

Now a new splicing method—developed by C. W. Blakeslee Company, New Haven, Conn.—adds to the already manifold benefits offered by high-strength, low-cost prestressed concrete piles. This unique, on-the-job technique increases the field of application at minor cost. For example, on jobs where the depth required to reach the specified load-bearing capacity cannot be predetermined accurately and/or where pile length may vary, it is now a simple matter to achieve the required pile length by splicing and continuing to drive. Materials cost for a 12" x 12" square pile splice is less than $2.00 and labor time within two man-hours. Driving can be resumed fifteen minutes after the splicing compound is poured.

The impressive qualities of prestressed concrete piles include: 1. Their ability to withstand extremely difficult driving conditions (far above the capabilities of reinforced piles). 2. Their transportability from fabricating yard to job site. 3. Their durability in sea water; being crackless they are virtually indestructible in all kinds of water. 4. Their greater column capacity over reinforced piles. 5. Their foot-for-foot economy. Complete details on prestressed concrete piles and the quick splicing method are immediately available. Write for them—and for information on tensioning elements for prestressed concrete—to Roebling Construction Materials, Trenton 2, New Jersey.

ROEBLING

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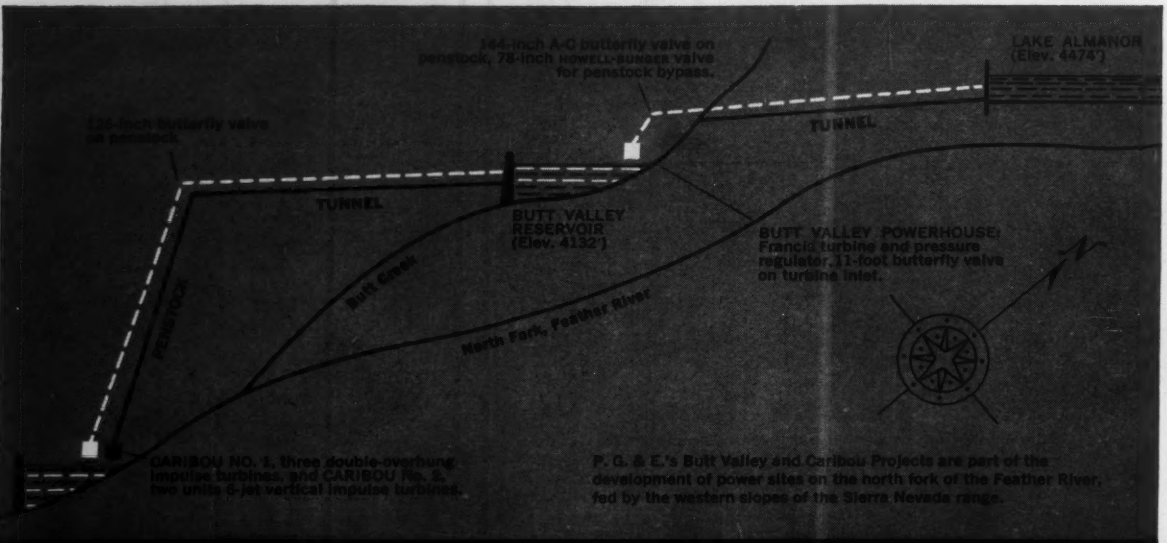
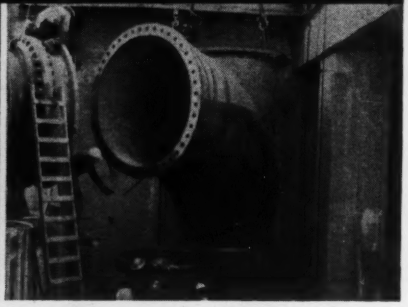
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation


144-inch A-C butterfly valve on penstock, 78-inch HOWELL-BUNGER valve for penstock bypass.
LAKE ALMANOR (Elev. 4474')
125-inch butterfly valve on penstock
TUNNEL
TUNNEL
BUTT VALLEY RESERVOIR (Elev. 4132')
BUTT VALLEY POWERHOUSE: Francis turbine and pressure regulator, 11-foot butterfly valve on turbine inlet.
PENSTOCK
Butt Creek
North Fork, Feather River
N
CARIBOU NO. 1, three double-overhung impulse turbines, and CARIBOU No. 2, two units 6-jet vertical impulse turbines.

P. G. & E.'s Butt Valley and Caribou Projects are part of the development of power sites on the north fork of the Feather River, fed by the western slopes of the Sierra Nevada range.

The 11-foot butterfly valve on the Butt Valley turbine inlet is shown being lowered into position.

Turbine spiral case in position at Butt Valley prior to the installation of the turbine runner.



Pressure regulator inlet elbow being positioned. Spiral case is at the left and energy absorber and discharge chamber below.

Allis-Chalmers Turbines, Pressure Regulator and Valves Installed at Butt Valley and Caribou Powerhouses, No. 1 and No. 2.

At Pacific Gas & Electric Company's new Butt Valley Powerhouse development, an Allis-Chalmers vertical Francis turbine with pressure regulator, two butterfly valves and one HOWELL-BUNGER valve are installed. This turbine is rated at 55,000 HP at 200 rpm under a 280-foot rated head.

A stalling-type pressure regulator, with provision for quick and simple conversion to synchronous bypass control, it's attached to the spiral case. Designed for a minimum opening time of 3 seconds, the pressure regulator is required because of the 5703-foot long penstock and the relatively remote location of the surge tank. An 11-foot A-C butterfly valve is located at the turbine inlet, while the other butterfly valve will be used as a penstock shutoff valve. The HOWELL-BUNGER valve serves as a penstock bypass.

Down stream from Butt Valley is Caribou No. 1 Powerhouse, with 3 Allis-Chalmers horizontal, double-overhung impulse units, 30,000 HP each, two units paralleled 1921, the third unit paralleled 1924, and Caribou No. 2 Powerhouse, completed along with Butt Valley in 1958. Caribou No. 2 has two Allis-Chalmers vertical, 6-jet impulse turbines, each rated 76,000 HP at 1110-foot head at 240 rpm. At each turbine inlet is a 54" rotary valve of latest Allis-Chalmers manufacture.

You can look to Allis-Chalmers for the latest in design, engineering and manufacturing of a complete line of hydraulic turbines and their accessories. For further information, contact your local Allis-Chalmers office or write Allis-Chalmers, Hydraulic Division, York, Pa.

HOWELL-BUNGER and ROTOVALVE are Allis-Chalmers trademarks

Hydraulic Division

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ALLIS-CHALMERS

1106

The Fabulous Ohio River Development

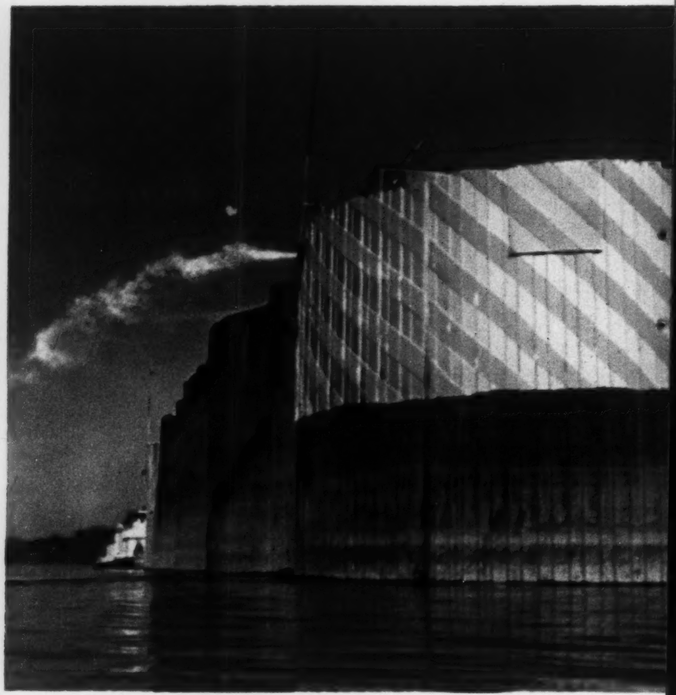
see story on following three pages . . . . . .

LOUISVILLE, KY.

Reconstruction of Lock No. 41 located 607 miles below Pittsburgh. This is a complicated job involving four cofferdams: Two main cofferdams, upstream and downstream and two guardwall cofferdams upstream and downstream. A total of 99 cells was constructed using 10,850 tons of USS MP 101 and MP 112 Piling in various lengths from 24 feet to 60 feet. General contractor—Hardaway Contracting Co., Columbus, Ga., under supervision of Louisville District, U. S. Corps of Engineers.

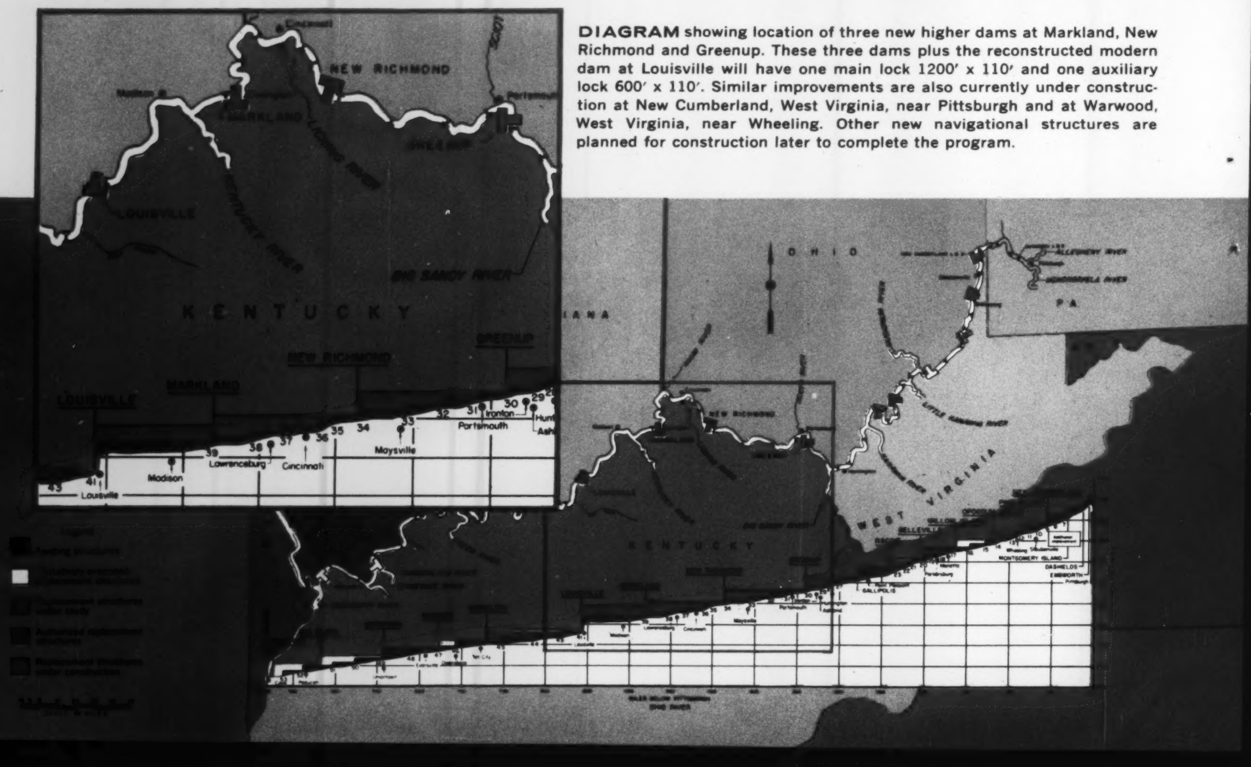
MARKLAND, IND.

Lock and Dam No. 39. Located 531.5 miles below Pittsburgh. Will replace five outmoded navigational facilities. One main lock 1,200 feet long by 110 feet wide and one auxiliary lock 600 feet x 110 feet. Dam gates are 42 feet high by 100 feet long. Lock cofferdam is 3,250 feet long, 50 feet high and contains 8,000 tons of USS Steel Sheet Piling. Lock construction recently completed by Dravo Corporation, Pittsburgh, Pa., under supervision of Louisville District, U. S. Corps of Engineers.



Between Greenup and Louisville . . . Four huge locks and

DIAGRAM showing location of three new higher dams at Markland, New Richmond and Greenup. These three dams plus the reconstructed modern dam at Louisville will have one main lock 1200′ x 110′ and one auxiliary lock 600′ x 110′. Similar improvements are also currently under construction at New Cumberland, West Virginia, near Pittsburgh and at Warwood, West Virginia, near Wheeling. Other new navigational structures are planned for construction later to complete the program.


Cincinnati
NEW RICHMOND
Madison
MARKLAND
LICKING RIVER
Portsmouth
GREENUP
LOUISVILLE
KENTUCKY RIVER
BIG SANDY RIVER
K E N T U C K Y
GREENUP
NEW RICHMOND
MARKLAND
LOUISVILLE
43
41
Louisville
Madison
39
Lawrenceburg
38
37
Cincinnati
36
35
34
Maysville
33
32
Portsmouth
31
Ironton
30
29
O H I O
ALLEGHENY RIVER
MONONGAHELA RIVER
PA.
LITTLE KANAWHA RIVER
WEST VIRGINIA
MONTGOMERY ISLAND
DASHIELDS
EMSWORTH
GALLIPOLIS
Legend

NEW RICHMOND, OHIO

Lock and Dam No. 34. Located 436.2 miles below Pittsburgh. Will replace four older structures. Two locks same size as those at Markland but the dam gates will be only 37 feet high. The lock cofferdam contains 13,465 tons of steel sheet piling and has a total of 56 cells. Maximum length of piling 84 feet. Cofferdam construction by Peter Kiewit, Omaha, Neb.; lock construction by Groves Ventures Company, Minneapolis, Minnesota, under supervision of Huntington, W. Va. District, U. S. Corps of Engineers.

GREENUP, KY.

Lock and Dam No. 30. Located 341 miles below Pittsburgh. Replaces four older structures. Two locks of the same size as Markland. Dam gates will be 37 feet high. The lock structure has been completed by Atkinson-United Companies. A total of 10,194 tons of steel sheet piling was used. Much of this was USS Steel. Lock chamber cofferdam by Dravo Corporation of Pittsburgh, dam and cofferdam by Massman Construction Co., Kansas City, Mo., under supervision of Huntington, W. Va. District, U. S. Corps of Engineers.

dams will replace 14 outmoded structures

USS Steel Sheet Piling is used in the cofferdams

The growing industrial development in the Ohio River Valley has boosted river traffic to more than ten times what it was 30 years ago. In 1957 it was 17 billion ton-miles. Barge tows are now longer and many have to be broken up every time they go through the old 600-foot locks.

To speed traffic, the billion dollar Ohio River navigation replacement and improvement program is now in full swing under the direction of the Ohio River Division Office of the Corps of Engineers at Cincinnati, Ohio.

The entire program includes replacement of the present 46 navigational structures with 19 modern facilities. It is estimated that when the program is completed, about 1975, two full days' locking time will be cut off the average running time from Pittsburgh, Pa., where the Ohio River begins, to Cairo, Illinois, where it enters the Mississippi.

In this stretch of river, between Huntington, W. Va., and Louisville, Ky., huge new locks 1200 feet long and 110 feet wide are going in at Greenup, Ky., New Richmond, Ohio, Markland, Ind., and Louisville, Ky. Three new non-navigable dams, built higher to maintain the nine-foot minimum navigable depth, will take the place of 13 old structures in this 300-mile stretch.

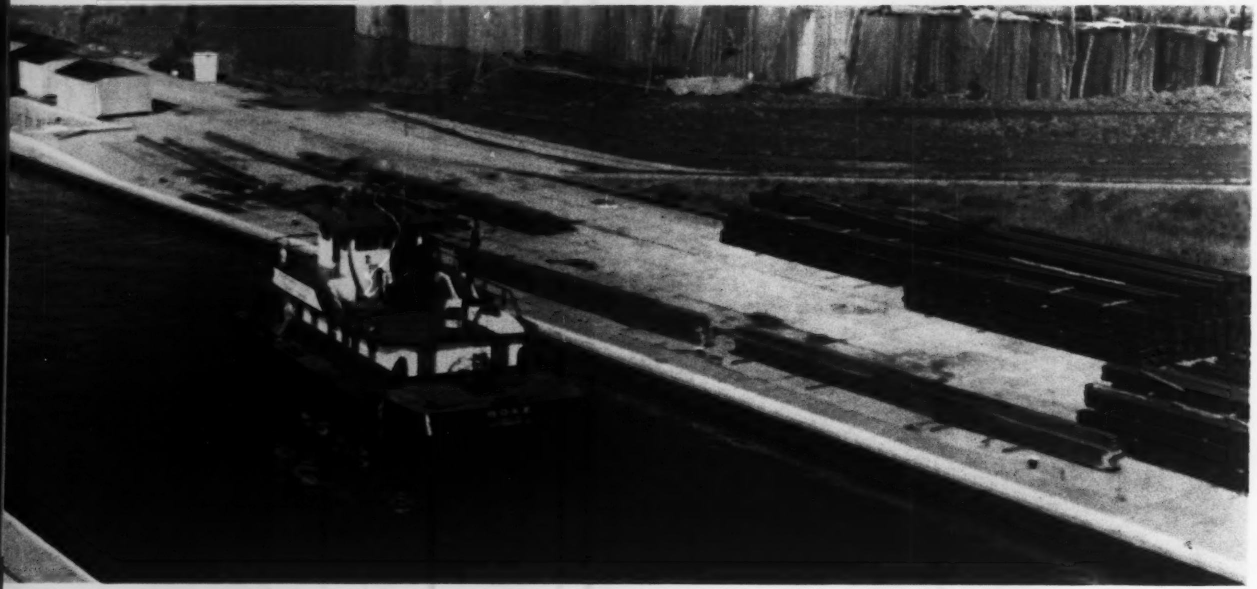
One of the first major jobs is to build steel sheet piling cofferdams to dry up the work areas. Thousands of tons of U. S. Steel Sheet Piling are being used in these temporary cofferdams. A large quantity of USS Sheet Piling is also incorporated into the permanent lock structures. U. S. Steel's production capacity insures ready availability of all popular piling sections and makes possible quicker deliveries to each of the job sites. This capacity is advantageously located to provide shipment by various means—in this case by economical water transportation. In addition to steel sheet piling, hundreds of tons of USS Steel H-Piles are being used to support major portions of the structures including the guard and guide walls and in some cases the dam structures.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company
United States Steel

Additional information on next page . . .

Building a cell at Louisville using a template to assure correct diameter.

USS Steel Sheet Piling stacked and ready for use after delivery by barge to Louisville.



Quick deliveries on USS Steel Piling

U.S. Steel's large production facilities and close attention to customer's needs have made possible "on-time" deliveries even in remote sections of the country. When you want any type of piling in a hurry—Steel Sheet Piling or Steel H-Piles—call the United States Steel office near you. For technical information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
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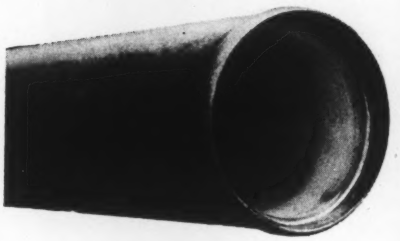
EXTRA SAFETY FACTOR!



CONSERVATIVE DESIGN is one of the important reasons why American Concrete Cylinder Pipe has gained such high acceptance by engineers and water works officials in the west. The composite design of the pipe is based on a factor of safety of 2¼ at the elastic limit of the pipe. American Concrete Cylinder Pipe will safely withstand sudden and severe increases of pressure – surge and water hammer – or the occasional concentrated external loadings met under unusual field conditions.

The *composite* action of the mortar lined steel cylinder, circumferential rod reinforcement and external mortar coating accounts for the consistently successful performance record of this type of pipe. The use of a minimum of 25% to, under certain conditions, 50% or more of the total required cross-sectional steel area as tension-wound circumferential reinforcement substantially increases the pipe's external supporting strength over that which would be obtained if all of the required steel area were placed in the cylinder alone.

Take advantage of American Concrete Cylinder Pipe's greater inherent strength through more effective use of materials – see an American sales engineer when planning your next project.

CONCRETE PIPE FOR MAIN WATER SUPPLY AND TRANSMISSION LINES

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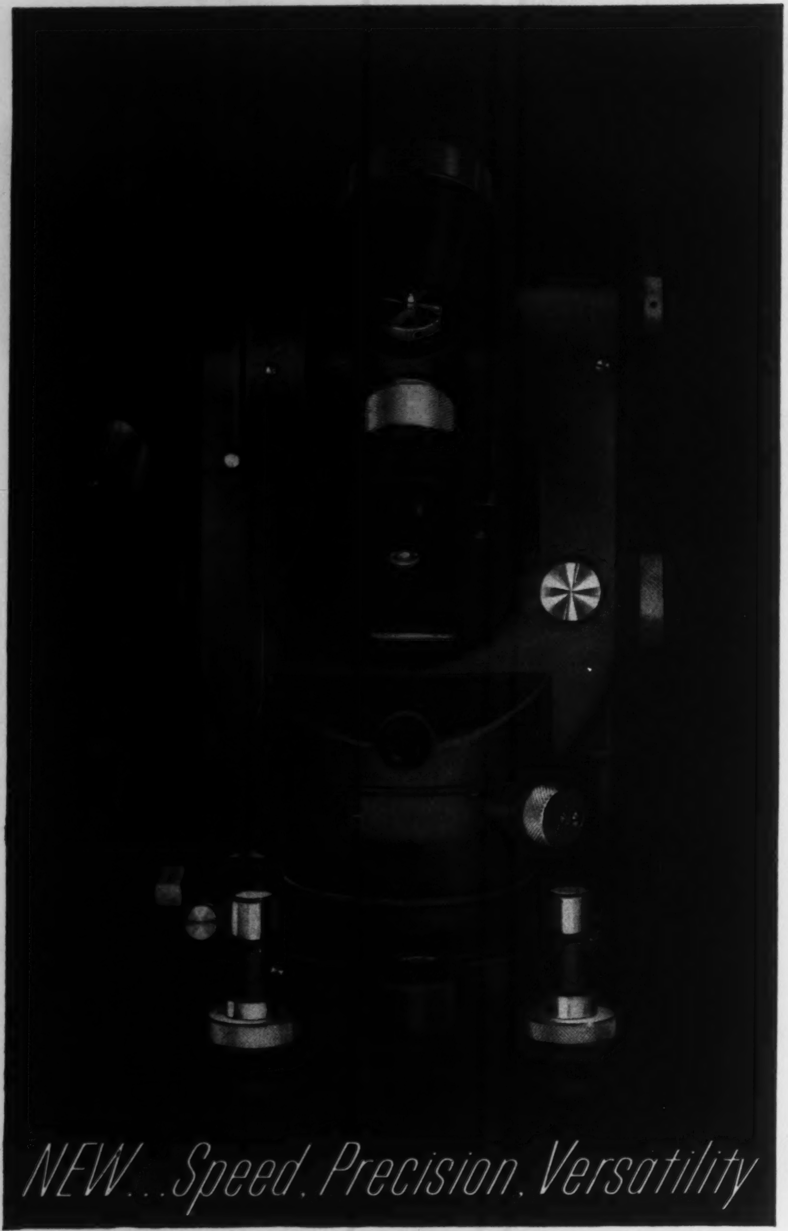

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All the ruggedness, simplicity, and trouble-free performance of the world renowned T-1...plus the convenience and extra speed of automatic vertical collimation setting.

Vertical angles can be read immediately after set-up. No need to center vertical circle level...no cleaning or maintaining moving parts.

Highway, mining, or any other surveying project, day or underground, becomes routine with the Wild T-1A.

Upper and lower motions for setting on zero and for repeating. Built-in optical plummet.

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FULL FACTORY SERVICES

Deceased

(Continued from page 104)

and New Mexico; and district engineer for the Housing and Home Finance Agency at Salt Lake City.

Ivor Livingston (M. '28; F. '59), age 81, retired engineer of Nashville, Tenn., died there on July 16. A graduate of the University of Tennessee School of Engineering in 1904, Mr. Livingston spent much of his career as a mining engineer in Tennessee and Kentucky. Prior to his retirement in 1950 he was also employed by the Internal Revenue Department as appraiser of mining property.

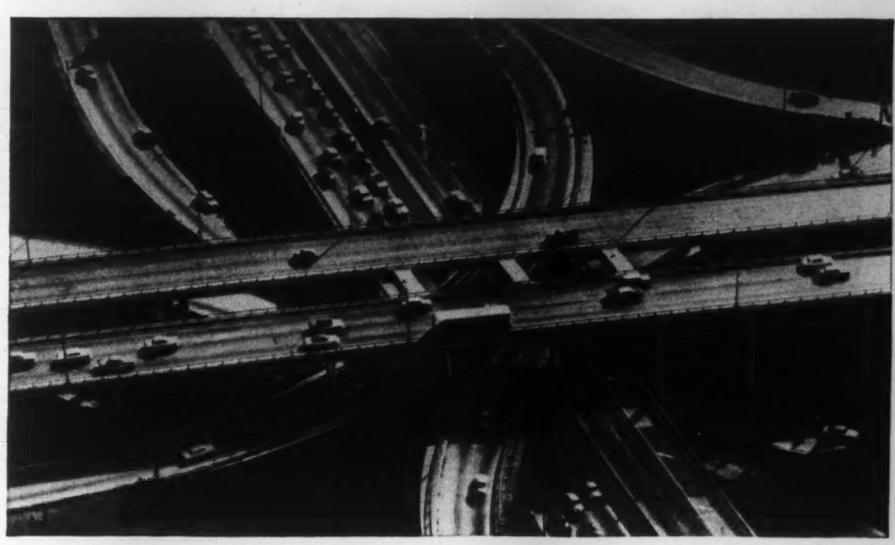
Manley Osgood (M. '19), age 71, died recently in Ann Arbor, Mich. At the time of his death Mr. Osgood was director of the Ann Arbor Construction Company, a post he had held since 1920. Part of this time he was also president and general manager of the company. For six years in his early career Mr. Osgood was city engineer of Ann Arbor. He was graduated from the University of Michigan.

Micajah Thomas Singleton (M. '25; F. '59), age 67, since 1925 a partner in the firm of Wiedeman and Singleton, Atlanta, Ga., died there on August 19. For his efforts in obtaining a state licensing law for professional engineers and surveyors, Mr. Singleton was appointed the first civil engineering member of the Georgia State Board of Registration, a position he filled for about twenty years. As a partner in Wiedeman and Singleton he was active in the design and construction of municipal improvements, particularly water supply, sewerage and sewage treatment, including many of the first complete sewage treatment plants constructed in Georgia. Mr. Singleton was a past-president of the Georgia Section.

Arthur W. Tews (M. '47; F. '59), age 57, city engineer of St. Paul, Minn., died there suddenly on August 23. A graduate of the University of Minnesota in 1924, he was an engineer for the Minnesota State Highway Department until he was named chief engineer at Duluth in 1945. In 1955 he went to St. Paul as assistant chief engineer of the Public Works Department and in 1957 he became chief engineer.

A. Judson Warlow (A.M. '10, M. '59), age 80, former chief engineer of the General State Authority of the Commonwealth of Pennsylvania, died at DeLand, Fla., on July 11. Mr. Warlow, a graduate of Lehigh University in 1905, began his career as a surveyor for the Lehigh Valley Coal Company. Later he was assistant superintendent of construction at the Sparrows Point, Md., plant of the Bethlehem Steel Company. He first went to work for the State of Pennsylvania in 1929, when he joined the Construction Bureau. Eight years later he was appointed chief engineer of the General State Authority.

Complex Interchange...



Four-level reinforced concrete Los Angeles Freeway separation structure

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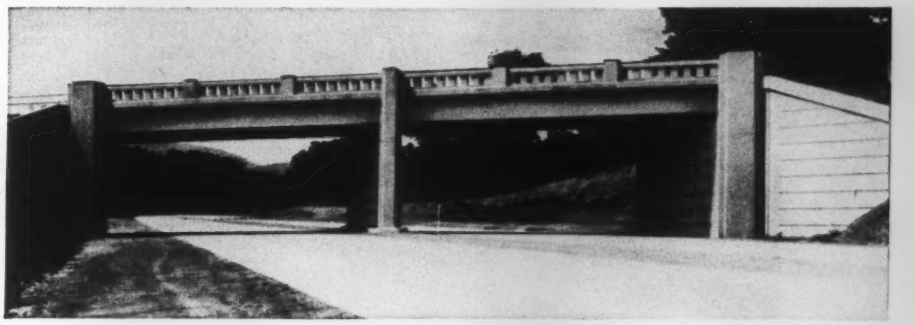

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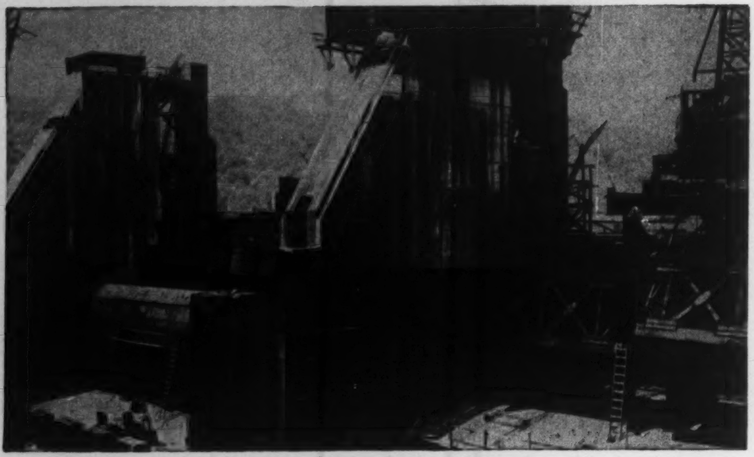

New Cumberland Dam, Ohio River, Corps of Engineers. Dravo Corp., General Contractors.

THE PROBLEM: Develop an anchorage for tainter gate trunnions that will result in minimum movement of the trunnions under maximum water pressures. Do this without using massive and complex combinations of reinforcing steel and large diameter tie rods.

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Applications for Admission to ASCE, Aug. 1-Aug. 29, 1959

Applying for Member

(Old Designation)

Tin Yeh, Islington, Ontario, Canada

Applying for Member

(New Designation)

Augustus Massillon Allen, Nashville, Tenn.
Tadeusz Andrzejewski, York, Pa.
Juan Ramon Brugueras, Hato Rey, Puerto Rico
John Abel Burke, Montreal, Quebec, Canada
William Robert Cooke, Springfield, Ill.
George Moses Cookson, New Orleans, La.
German De la Reza, Newark, N. J.
Alfred Charles Etzel, Jr., Allentown, Pa.
Donald Henning Eyinck, Fairbanks, Alaska
Ralph Oliver Fisher, Springfield, Ill.
Robert Roy Frazier, St. Louis, Mo.
James Nelson Glenn, Wilmington, Del.
Charles Fredrick Hains, Menlo Park, Calif.
Chris Anthony Hanson, Washington, D. C.
Louis Gerard Hecht, New York, N. Y.
George Weisbrod Keffer, Washington, D. C.
Earle Frenage Kerber, Philadelphia, Pa.
Maxon Horace King, Greenboro, N. C.
Donald Hankey Martin, Little Rock, Ark.
Augustine Edward Meehan, Omaha, Nebr.
George Dwight Mock, Washington, D. C.
John Marcus Norvell, Washington, D. C.
C. Raymond Nowacki, Rolla, Mo.
Lilburn Murray Pipkin, Jr., Springfield, Ill.
Rosario Joseph Russo, Bribane, Australia
William Herbert Shoemaker, North Brunswick, N. J.
William Dixon Smith, College Park, Md.
Francis Warren Steele, Washington, D. C.
Frank Donald Steiner, Moraga, Calif.
Ernest John Stephen, Vancouver, Canada
Frank Stolle, New York, N. Y.
Sardari Lal Sunnak, London, England
Villem Tammekivi, Chicago, Ill.
Leslie Barnard Taylor, Miami, Fla.
Alfred George Vollmar, Flushing, N. Y.
Richard Donald Weisser, Kansas City, Mo.
Harold Albert Wentzel, Hurst, Tex.
Nicolaas Willems, Pretoria, South Africa
Kenneth Lewis Wilson, Rolla, Mo.

Applying for Associate Member

(Old Designation)

Eduardo Luis Alsina, San Jose, Calif.
George Henry Siems, Jr., Baltimore, Md.

Applying for Associate Member

(New Designation)

LeRoy Ashley, Jr., Corpus Christi, Tex.
Stewart Bashian, Harrisburg, Pa.
Howard Beal Browning, Tulsa, Okla.
Estenio Rosell Calderon, Jersey City, N. J.
Brian Victor Carter, Queensland, Australia
Charles Joseph Chaloff, Cambridge, Mass.
Marvin Vincent Craft, Jr., St. Louis, Mo.
Nelson Luiz DeSousa Pinto, Allenspark, Colo.
Tonie Lazarus Doka, Kingsport, Tenn.
Robert Charles Fuhr, Cincinnati, Ohio
Assadour Hagop Hadjian, Beirut, Lebanon
Hekmat Hakimian, Chicago, Ill.
Frederick Karl Hanack, Boston, Mass.
Albert Emmanuel Hazbun, San Francisco, Calif.
William Richard Hoover, Maracaibo, Venezuela
Edwin Whipple Houser, La Mesa, Calif.
Francis Joseph Kaelin, New York, N. Y.
Won Man Kim, Baltimore, Md.
Andrew Richard Kopec, Somaliland Protectorate, East Africa
Colin Gordon McMillan, Shalalth, B. C., Canada
Charles Arnold Moffitt, La Puente, Calif.
Peter Alabi Chukwudebelu Okafo, Umuahia, Nigeria
Robert Francis O'Neill, Washington, D. C.
Charles Sylvan Oulman, Ames, Iowa
Shirish Bhailal Patel, Bombay, India
Victor Pinkston Scott, Canton, Ohio
Alfred James Smith, Pampa, Tex.
Herbert Josef Stolz, Vancouver, Canada
Muhammad Amil Tahir, Baghdad, Iraq
Robert Francis Turner, Libby, Mont.
Charles Oral Velzy, New York, N. Y.
Polyvois Constantine Vintiades, Boston, Mass.
Richard Michael Weidner, Crystal Lake, Ill.
Kenneth Gustave Wiman, Juneau, Alaska
Simon Lustig Yaron, New York, N. Y.

Applying for Affiliate

Frederic Brewster Loomis, Sacramento, Calif.

[*Applications for the grade of Associate Member from ASCE Student Chapter Members are not listed*]

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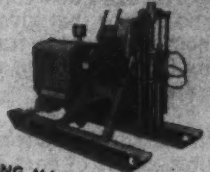

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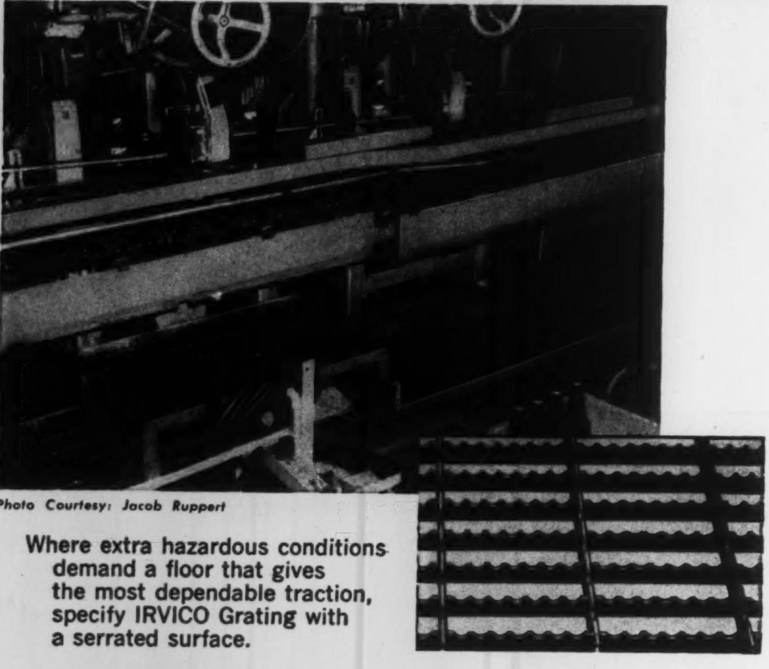

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New in Education

Graduate programs in urban renewal . . . Starting in the fall of 1960, an advanced course leading to one of three new master's degrees in urban design will be offered in the *Harvard Graduate School of Design.* This course will be open to selected candidates who have demonstrated capacity in design as applied to improvement of the urban environment and who hold one of the professional degrees of the Graduate School of Design in architecture, landscape architecture, city planning, or the equivalent. The new program will require a minimum of one year's study in residence at Harvard. . . . Fellowships, which carry stipends plus full tuition, are available for full-time students registered for the degree of Master of Public Administration (Planning) or the degree of Doctor of Philosophy with a major in public administration and concentration in urban and regional planing and housing under the newly established Werner Hegemann Fellowships and Scholarships at the *New York University Graduate School of Public Administration and Social Service.* Scholarships, which provide full or partial tuition, are also available for full-time or part-time students. Dr. Werner Hegemann (1880-1936), in whose honor the fellowships and scholarships were established, was an international authority and leading educator in the fields of city planning and housing. . . . The *Graduate School of Public and International Affairs of the University of Pittsburgh* has established a new type of master's degree program in urban renewal and redevelopment. First of its kind, the program will focus on the problems faced by our cities in creating livable communities adequate for the impending explosive growth in population. It will emphasize the work-shop approach. The student's principal laboratory will be the Pittsburgh region, which has gained world-wide recognition for its pioneering achievements in urban renewal and redevelopment. Fellowships varying from $500 to $1,500 are available for full-time students, while two staff assistantships, involving part-time work at a salary varying from $2,000 to $3,500, will be awarded to qualified and experienced individuals.

Highway research . . . Twenty-one projects involving $342,100 will be carried on for the Illinois State Division of Highways at the *University of Illinois* during the next year according to Prof. Ellis Danner, F.ASCE, coordinator of highway research. Intensive information gathered recently about traffic movement in the Champaign-Urbana area will be utilized and extended to include the effects of new superhighways now being built. The new projects include studies of welded structures, grass and woody plant ground cover, drainage laws and practices, and land appraisal.

(Continued on page 124)

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Atlas White Cement marks the curve day or night

Reflecting concrete curbing made with Atlas White portland cement marks the road's course—every straightaway, curve and turn—well ahead of the driver. By day, the white surface stands out in contrast to darker road paving. By night, saw-toothed corrugations reflect the car's headlight beams back to the driver for greater visibility. And rainy weather actually heightens the effect; wet curb surfaces become even more reflective.

For more information on the use of Atlas White portland cements in highway and street construction, write Universal Atlas, 100 Park Ave., New York 17, N. Y.

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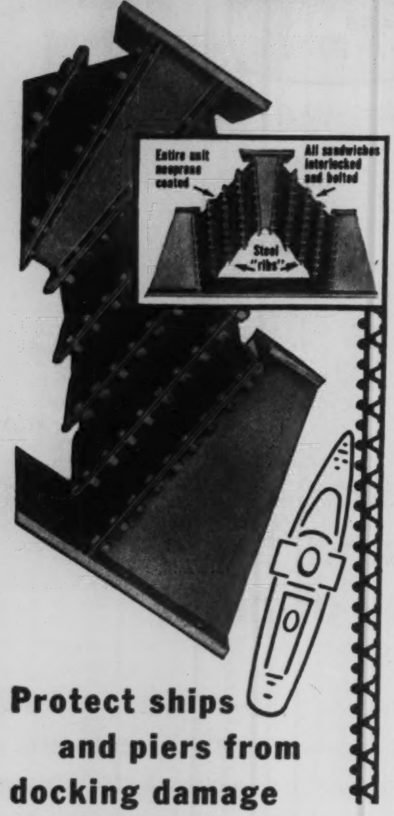
RUGGED RAYKIN FENDER BUFFERS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RECENT BOOKS

(added to the Engineering Societies Library)

Asbestos: Its Industrial Applications

The use of asbestos in industry is described, and data are given on its properties and manufacturing methods. The types of asbestos materials available are reviewed, including asbestos cement, tile, asbestos heat and electrical insulation, asbestos friction materials, textiles, plastics, packings, gaskets, and filters. A census of asbestos products and a bibliography relating to the uses of asbestos are also given. (By D. V. Rosato. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1959. 214 pp., bound. $5.75.)

Building Construction Estimating

Second Edition

The nature of the work of the estimator is covered in detail, and the various phases of contracting are discussed. The book begins by discussing contracting as a business, building codes, plans, specifications, contracts, and the general techniques of estimating. It continues with the estimating of work customarily performed by the general contractor's men, and with the estimating of work done by the subcontractor's men. All of the required materials for study are given, including two sets of plans, many specimen estimates, and essential reference data. (By George H. Cooper. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 398 pp., bound. $5.50.)

The Design of Land Drainage Works

Papers on a variety of aspects of flood protection and alleviation, ground-water level control, water conservation, irrigation, and protection of low-lying land against the sea. They are intended to provide a concise reference for everyday use by design engineers, and include such topics as flood hydrographs, hydraulic calculations for channel improvement schemes, flow in alluvial channels, fluming for land drainage works, tidal outfalls, automatic radial sluice gates, land drainage pumping stations, and earthen flood banks. Each paper is accompanied by explanatory notes that serve both as an introduction to the paper and as a means of supplementing the information contained in it. (By Roland B. Thorn. Butterworth and Company, 1367 Danforth Avenue, Toronto 6, Ontario, 1959. 235 pp., bound. $7.00.)

The Design of Shells

The fundamental aspects of the design and analysis of shell structures are presented. Although the book deals at length with the theory of the subject, it is practical in its approach to the problems involved, and deals with the design of actual structures. Aspects treated are the membrane theory, the differential equation of shells, symmetrical problems, the end and North shell, shells with prestressed boundary beams, anisotropic shells, plate approximations, the balanced shear method, and end frames and arched beams. (By Albin Chronowicz. Frederick Ungar Publishing Company, 131 East 23rd Street, New York 10, N. Y., 1959. 202 pp., bound. $8.50)

Digital Computing Systems

The structure of modern electronic computing systems is described in relatively non-mathematical terms. Beginning with the various codes needed to represent data, the elements contained in modern computers are then described including input and output devices, storage devices, circuits and components, and arithmetic units. A brief review of how digital computers are used to solve scientific, business and data handling problems concludes the book. (By Samuel B. Williams. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 1959. 229 pp., bound. $7.75.)

Electronic Digital Computers

A comprehensive picture of the basic principles underlying computing machines in use today. The book begins with practical information on such aspects as digital-computer arithmetic, general considerations of systems, circuits and their components static and dynamic cells, large-scale memory devices, shifting registers, and adders and accumulators. It then indicates how the basic circuits and devices are assembled and interconnected to form the main units of a computer, and specifically describes the organization of the parallel direct-coupled asynchronous machine developed at the Institute for Advanced Study. (By Charles V. L. Smith. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 443 pp., bound. $12.00.)

Elementary Practical Hydraulics of Flow in Pipes

A combination textbook and reference work intended for those responsible for the design, layout, installation, and operation of the supply, distribution, and circulating systems of liquids. Aspects covered are water at rest and in motion; quantity, velocity, and diameter; viscosity and Reynolds numbers; flow through orifices, over weirs, and in pipes; exponential and logarithmic formulas for the flow of water in pipes; friction in bends and changes of section. Calculations, tables, and charts are duplicated in the British and Metric systems. (By C. T. B. Donkin. Oxford University Press, 417 Fifth Avenue, New York 16, N. Y., 1959. 207 pp., bound. $3.40.)

Engineering Education in Russia

An analysis based on the author's knowledge of the prerevolutionary Russian educational system and on a visit to Soviet engineering and technical schools in 1958. The book begins with a brief history of Russian engineering education and then describes some important Russian engineering schools. It also includes a discussion on the present state of Russian engineering education and a comparison of the curricula of American and Russian schools. (By Stephen P. Timoshenko. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1959. 47 pp., bound $2.75.)

Flow Measurement and Control

Emphasizes practical measurement and control of flow rather than theoretical concepts. Beginning with a classification of fluid meters and with tables of capacities, the book includes a discussion of differential head meters; primary elements for measuring differential pressures; the installation of pressure difference devices; a detailed consideration of weirs and flumes; and a survey of typical instruments used in the measurement of fluid control. It concludes with automatic control, control of continuous processes, and miscellaneous control installations. (By W. F. Coxon, The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1959. 312 pp., bound. $11.00.)

Formulaire de la Construction

Volume I: Bétons—Bétons Légers—Maçonneries

The first volume of this handbook on construction deals with concrete, lightweight concrete, and masonry, with major emphasis on lightweight concretes. The book is oriented to the practical rather than to the theoretical aspects of construction, and the information is copiously illustrated with tables, charts, formulas and diagrams arranged for quick reference. There are bibliographies at the end of each chapter. (By G. Laval. Dunod, Paris, France, 1959. 363 pp., bound 5,900 frs.)

Frames and Arches

This volume in the Engineering Societies Monograph Series presents a solution to the analysis of frames or arches of constant or variable cross-section, which is based on the classical method, in a convenient, practical form. Time required for frame analysis is considerably reduced. Over 400 condensed solutions for twenty principal types of statically indeterminate frames and arches are given, each solution applying to a particular

(Continued on page 123)

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Set it up fast

. . . batcher section is raised into position, hinged columns are lowered and bolted in place . . .

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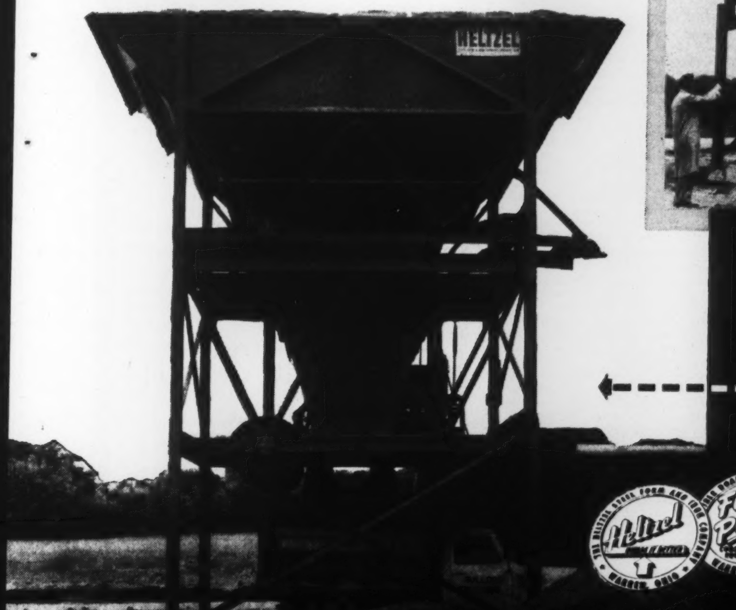
Start batching



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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

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Assistant to Superintendent, Transportation and labor, M. ASCE, B.S. in C.E., age 35. Three and a half years of railroad operations research, and six years' supervision of railroad maintenance and construction in the field. Location open. C-491.

Civil Engineer, M. ASCE, M.S.C.E., age 30. Seven years of experience on airport planning and engineering, including individual project planning and site planning, administration of arch-engineer planning contracts, aerial photo interpretation and site surveys; employed as airport engineer on construction, utilities and maintenance, and as designer prepared plans, specifications and estimates. Desires position in engineering management, (professional registration to be sought as soon as practicable), available immediately. Prefers Boston, Northeast, West Coast, North Central Middle West. C-492.

Civil Engineer, hydraulic and structural, J.M. ASCE, B.S. in C.E., graduate studies, E.I.T. California, single completed military active duty, age 35. Two years of experience in drafting, designing hydraulic and various engineering structures, and produced engineering and economic studies. Prefers San Francisco, Los Angeles or New York. C-493.

Sales-Service Consulting, F. ASCE, B.S.C.E. Registered P.E., age 49. General highway engineering, all operations. Eight years on maintenance and construction of concrete structures, and twenty years' experience on all types of structures. Location desired, Midwest. C-985-Chicago.

Office or Field Engineer, A.M. ASCE, B.S.C.E., age 34. Two and one half years' designing irrigation systems, flood protection system and related structures; two years on stress analysis and design of wooden structures; and four and one-half years as combination field and office engineer in construction. Good work organizer and manager. Prefers Southwest, South or Midwest. C-901-Chicago.

Development Engineer, M. ASCE, B.S.C.E., registered P.E., age 33. Varied experience in construction, research and development on construction materials, and as supervisor of engineers and draftsmen Fluent writer. Location desired, Midwest. C-992-Chicago.

Salesman and Estimator, Steel Products, Tronics, A.M. ASCE, C.E., age 31. Four years on sales, estimates, and production of steel products for fabricator; eight months conducting electronic test of radar systems on aircraft, and six and one-half years as tronic technician for Navy. $650 per month. Prefers northern California. S(M)-1890.

Sanitary Engineer, Public Works, F. ASCE, C.E. California Civil Engineer License, age 44. Five years as assistant county engineer; three years as road commissioner for county; five years' preparing reports, plans, specifications on sewage treatment plants, water supply, structural design of bridges, buildings, dams, and airports for consultant; one year in charge of design and plans for structural and hydraulics, cement plants, and three years as assistant hydraulic engineer on water resources. $12.000. Prefers San Francisco Bay Area, or California. S(M)-659.

Aircraft Structural Designer, A.M. ASCE, C.E., age 27. Two months on design and detail jet engine test stands for consultant, eight months on stress and weight analysis of jet fighter type aircraft for manufacturer; four years with the Navy making aircraft performance calculations (completed). $450 per month. Prefers San Francisco, Los Angeles. S(M)-595.

Municipal Designer Structural, A.M. ASCE, C.E. California Civil Engineer License, age 40. Two years as structural designer; two years as municipal engineer; and five years as lake foundations engineer in Latin America. Fluent Spanish. Salary open. Prefers Latin America. S(M)-548.

Structural Designer and Contractor, A.M. ASCE, C.E. California Civil Engineer License, age 29. Three years on airfield construction, concrete, soils and asphalt; two years on structural design hangars, warehouses, mill buildings; and one and one-half years on design of railroad bridges, retaining walls and foundations. $650 per month. Prefers Los Angeles. S(M)-525.

Construction Manager and Superintendent, M. ASCE, C.E., age 50. Twelve years as manager of contracts, construction, maintenance, engineering, equipment pool, warehousing, personnel, specifications, estimates for consulting engineers and builders on construction; and twenty-one years as owner of construction company. $10,000 up. Prefers San Francisco Bay Area. S(M)-444.

Construction Designer, A.M. ASCE, C.E., age 31. Four years on design and layout of roads, streets, sewers, drainage, grading railroads, airports, concrete and steel buildings; and making estimates and shop drawings for consultant. Five months as data engineer, reducing and analyzing experimental flight test data for aircraft company. Four years as Air Force Pilot. One and one-half years' computations on hydrographs, drainage, structures, pipe sizes, levees and dredge surveys. $700 per month. Prefers West or Southwest. Home: Missouri. S(M)-1809.

Designer and Surveyor, A.M. ASCE, M.S.C.E. age 27. Three years on design, right-of-way determination, survey and inspection on highway construction; and three months as surveyor's assistant, land survey. $625 per month. Prefers San Francisco Bay Area. S(M)-1082.

Sanitary Engineer, M. ASCE, C.E., age 48. For nine years did studies, reports, designs, estimates, plans and specifications on sewerage and water supply for consultants. Employed eight years as sanitary engineer by federal and state public health agencies; and one and one-half years as chief administrative officer for small city. $700-800 per month. Prefers West Coast. S(M)-671.

Designer, Estimator and Superintendent, F. ASCE, C.E. California Civil Engineer License, age 48. Sixteen years' estimating plant, equipment and structural design, and supervising all types of heavy construction; one year supervising construction of buildings and facilities for Army; and two years as junior engineer on dam and air base construction. $15,000 a year. Prefers California. S(M)-373.

CHIEF CIVIL ENGINEER

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Must be graduate civil engineer with state registration in civil engineering. Minimum five years experience in the supervising of thirty or more engineers, designers and draftsmen.

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SENIOR CIVIL ENGINEERS

(FAR EAST ASSIGNMENT)

Experienced hydrologists or possibly hydroelectric engineers with good background in river basin development. Person selected must be able to speak, read and write both French and English.

Applicant must go in single status as no family housing available for either position.

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Construction Superintendent, A.M. ASCE, C.E. Kansas Civil Engineer License, age 32. One year as construction supervisor on military projects, missile sites, buildings and road work; six years on construction schedule, cost reports on gas pipeline construction, cost estimates on large industrial projects, design of water and sewerage treatment plants and small dams, as field superintendent on chemical plants and refineries, and on highway designer for engineers, constructors. $725 per month. Prefers northern California. S(M)-331.

Structural Designer, M. ASCE, Structural Engineer, (Austria), age 43. Sixteen years as designer of residential and commercial buildings, as well as foundations for steel mills, bridges and towers for consultants. Experienced in steel, concrete, and timber construction. $700 per month. Prefers San Francisco Bay Area. S(M)-258.

Heavy Construction Superintendent, A.M. ASCE, C.E., age 31. Five years on design and construction of highways, bridges, roads, concrete batch plants and asphalt plant for public works; one and one-half years supervised mass grading, underground utilities, streets, scheduling, development, and design of land development; and one year of junior civil engineer on bridge construction for public works. $10,000. Prefers West. S(M)-256.

Positions Available

Civil or Structural Engineer, graduate, licensed for structural design, estimating and supervision of construction field work for prestressed manufacturing plant. Salary, $5,500-$9,000 a year. Location, South. W-7674.

Resident Engineers. (*a*) Resident engineer, to age 35, civil graduate preferred but will consider mechanical or electrical; minimum of six years' in engineering and construction, three years' of which must have been in the field supervising construction of manufacturing plants and preferably also some supervision of office structures or other commercial buildings. Will have full responsibility for supervision of contractor's work in the constructon of sizeable prjects. Salary, $8,640 a year to start. (*b*) Associate resident engineer, age 24-29, civil graduate preferred but will consider mechanical or electrical; at least two years of experience in the field, supervising construction of manufacturing plants, office structures or other commercial buildings. Will supervise smaller projects or assist on larger projects. Salary, $6,600 a year to start. Some travel on both positions. Headquarters, upstate New York. W-7830.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

Assistant City Engineer, graduate civil, qualified for registration in the State of Iowa. Duties will include general municipal engineering and administrative duties. Opportunity for advancement. Salary, to start, $6,000-$7,200 a year. Location, Iowa. W-7864.

District Engineers, age 30-45, either a civil or architectural engineering degree, preferably with a major in structural design. Experience in design and construction in structural steel in a consulting engineer's office, with a structural steel fabricator, a contracting organization or in the teaching profession; some sales promotion experience; design and construction experience in reinforced concrete and other structural materials; also some trade association experience desired. Salary open; insurance and retirement plans offered. Employer pays placement fee and relocation expenses. Some travel. Location, upstate New York and Western Pennsylvania. W-7869.

Soils Engineer, Master's degree in soil mechanics, registration desirable but not necessary, for position as assistant manager in growing foundation engineering and testing corporation. Profit sharing. Location, Midwest. W-7883.

Architectural Engineer with a minimum of five years' experience, with a knowledge of building materials and modern construction practices. Should be familiar with building layouts and the preparation of architectural specifications. Experience in directing architectural work including supervision of architectural and structural drawings. Salary, $8,000-$12,000 a year. Location, eastern Pennsylvania. W-7895.

Civil Engineers. (*a*) Senior highway engineer experienced in design of modern highways to head highway design section of small consulting firm. Should have talent for original planning and good personality for client relationships. Excellent opportunity. Salary open. Location, central New York. (*b*) Structural engineer for design of industrial structures, bridges and other civil engineering projects. Small reputable engineering office. Work very diversified. Salary commensurate with experience. Apply by letter giving description of training, experience and prior salaries: company pays placement fees. Location, upstate New York. W-7901.

Civil Engineers. (*a*) Highway design engineer with experience or background in soils engineering, young, Master's in soils engineering, with at least four or five years' experience in highway design. (*a*) Bridge designer with at least three or four years' experience. (*c*) Civil engineer, graduate, with one to two years' experience in general civil engineering. Salaries commensurate with experience and capabilities; fringe benefits. Location, Connecticut. W-7908.

City Planner, civil graduate, with five years of supervisory experience in municipal engineering and city planning. Salary $8,000-$10,000 a year. Location, Long Island, New York. W-7912.

Engineers. (*a*) City engineer, college graduate, with four years' experience, for an attractive and rapidly growing community of 52,000. Salary open. (*b*) Planning director, degree in landscaping architecture, civil engineering or urban planning. Salary open. Location, Ohio. W-7922.

Assistant Township Engineer, age 30-40. graduate civil; either registered in New Jersey or able to secure registration. Should have several years of field and office construction experience, preferably with some municipal work. Salary, $8,000-$10,000 a year. Location, Essex County, New Jersey. W-7931.

Promotional Engineer, field and office experience, for position as assistant to managing director of a trade association. Will prepare technical reports and articles, attend technical meetings, discuss problems with manufacturers and promote use of concrete pipes. Good sales personality. Some travel by air but home most weekends. Salary, $7,000-$10,000 a year depending upon ability and experience. Employer will pay placement fee. Location, Chicago, Illinois. C-7674.

County Engineer, registered P.E. in Florida, experience in the design and construction of roads, bridges, and drainage facilities. Must have administrative ability and experience. Salary open. Location, Florida. W-7939.

Office and Field Engineer, civil engineer graduate from recognized college, to age 35. Minimum of one, preferably five years' experience related to design and contract administration of canals, irrigation structure and water distribution for design or field office contract administration. For an engineering builder. U.S. citizens. $6,000-$8,400 a year. Employer pays placement fee. Central or Sacramento Valley. S(P)-4682.

Senior Designer and Draftsman, civil engineer graduate or equivalent, with civil and structural experience, to design and draft civil and architectural plans of buildings, water and sewers, airports, irrigation and air conditioning for architect-engineer firm. Preferably married, under age 40. Starting salary to $800 per month for very good man. Southern California. S(P) 4681-R.

Geologist, civil engineer graduate and California Professional License, with knowledge of concrete and soil mechanics plus some experience in civil engineering, geophysics and groundwater hydrology. Salary open. Southwest. S(P)-4668.

Designer and Draftsman, civil engineer graduate with EIT, young and able to assist in design, drafting and do general engineering work and handle small office during principal's absence for a small consulting engineering office. Fifty percent subdivision, some general building and water supply. Salary at going rate. San Francisco East Bay. (S(P)-4674.

Advisors, minimum requirements engineering degree and registration, also fifteen years of experience desirable. Men with families considered, but single men preferred. Complete logistic support provided. (*a*) Construction management engineer, to advise resident engineer, $14,300 a year. (*b*) Structural engineer, to advise chief of design (2 needed), $13,500 per year. (*c*) Materials engineer, to advise chief of foundations and materials, $12,000 per year. (*c*) Construction accountant, to advise comptroller, $12,000 per year. (*e*) Contract and procurement specialist, to advise chief of supply division, $12,000 per year. Apply by letter. Salary plus $1,800 housiig allowance per annum for family. For architectect-engineer. Korea. S(P)-4558.

Airport Engineer, civil engineer graduate or related and at least two years of professional experience, at least one year in airport design. Must have valid private pilot license and Class III medical certificate. For all phases of engineering work on aviation program—studies, preliminary design of airports, preparation of plans, and to supervise construction in field. $587-$713 per month. Southern California. S(P)-4531.

Designers. (*a*) Civil engineer graduate and five years' experience and professional registration in California, to head up hydraulic section responsible for water program. $749-$909 per month. (*b*) graduate and three years' experience to design and supervise design of flood control structures, including open channels, storm drains, basins and appurtenant structures of reinforced concrete, masonry, earth construction. $647-$786 per month. (*c*) graduate to assist with supplemental water program, collect hydrological field data, ground water, land use and other investigations, compile data and prepare reports on water supply, diversion, utilization. $507-$616 per month. Southern California. S(P)-4530.

Director of County Water Resources Department, civil engineer graduate plus regisrtation, or qualified for registration. Minimum three years' recent responsible engineering experience in water resources planning, responsible to Board of Supervisors, coordinate water resources, develop cooperation with Federal and State agencies, handling all matters relating to water resources, contracts and plans with governmental or private agencies to handle matters relating to flood control, exchange engineering data and represent country. For northern California County. $9384-$11,400. S(P)-4665.

Designers (*a*) Assistant dams design consultant, minimum seven years' design experience with five years' in general heavy construction design, preferably hydraulic structures. Minimum two years' experience should be in design of dams, preferably arch type. (b) Assistant civil design with minimum of seven years design experience, of which five years should be in general design of hydraulic structures, such as dams and spillways. Two years' design preparation of construction drawings for miscellaneous hydraulic structures essential. Family status assignment, new housing, allowance. privileges; minimum sixteen months contract. High salary, commensurate with experience and ability. Overseas (Asia). S(P)-4663.

TECHNICAL
EDITOR

Civil engineering graduate, in his twenties, wanted for position as assistant technical editor. Some experience is desirable but can be weighed against other important attributes such as innate ability to recognize good English and to deal diplomatically with fellow engineers and authors.

Recent graduates and discharged servicemen with exceptionally good references will be considered. Beginning salary is dependent on qualifications. Liberal vacation, sick leave, hospitalization, and retirement plans.

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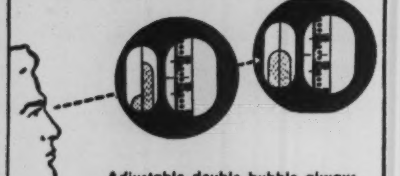

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Non—ASCE Meetings

American Concrete Institute. Twelve regional meetings at the Continental Hilton Hotel and the Hotel Del Prado, Mexico City, Mexico, November 3-5. For advance information write to Charles L. Cousins, American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich.

American Congress on Surveying and Mapping. Western Regional Conference at the Statler-Hilton Hotel, Los Angeles, Calif., October 28-31. For details write Walter S. Dix, Executive Secretary, American Congress on Surveying and Mapping, 905 Washington Building, 1435 G Street, N.W., Washington 5, D. C.

American Institute of Mining, Metallurgical and Petroleum Engineers. Joint Solid Fuels Conference with the American Society of Mechanical Engineers at the Netherland-Hilton Hotel, Cincinnati, Ohio, October 27-29. Advance information from Julian E. Tobey, General Chairman of the Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, 29 West 39th Street, New York 18, N. Y.

American Nuclear Society. National meeting at the Sheraton-Park Hotel, Washington, D. C., November 4-6. Information concerning hotel facilities available from Octave J. Du Temple, Executive Secretary, American Nuclear Society, 86 East Randolph Street, Chicago 1, Ill.

American Public Health Association. Annual meeting at Convention Hall, Atlantic City, N. J., October 19-23. Address requests for information to the American Public Health Association, 1790 Broadway, New York 19, N. Y.

American Society for Metals. Forty-first national metal exposition and congress at the International Amphitheatre and Exhibition Hall, Chicago, Ill., November 2-6. Headquarters are to be in the Hotel Sherman.

Seminar on Resonance and Relaxation in the Ballroom of the Hotel Sherman, Chicago, Ill., October 31 and November 1.

Information from the American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio.

American Standards Association. National conference on standards at the Sheraton-Cadillac Hotel, Detroit, Mich., October 20-22. For further details write to the American Standards Association, 70 East 45th Street, New York 17, N. Y.

Building Research Institute. Fall conference at the Shoreham Hotel, Washington, D. C., November 16-19. For further details write to the Building Research Institute, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C.

Pacific Northwest Sewage and Industrial Wastes Association. Annual meeting at the Tioga Hotel, Coos Bay, Ore., October 29-31. Requests for information should be sent to Gilbert H. Dunstan, Secretary-Treasurer, P. O. Box 176, Pullman, Wash.

Prestressed Concrete Institute. Fifth annual convention at the Deauville Hotel, Miami Beach, Fla., November 1-7. Address queries to the Prestressed Concrete Institute, Peter Larkin, Convention Headquarters, 3132 N. E. Ninth Street, Fort Lauderdale, Fla.

Texas A. & M. College System. Second Annual Texas Conference on the Utilization of Atomic Energy on the campus of the A. & M. College of Texas, College Station, Tex., November 12 and 13. Information about the conference, hotels and advance registration from Dr. George M. Krise, Radiation Biology Division, Texas Engineering Experiment Station, Texas A. & M. College System, College Station, Tex.

News of Members

(Continued from page 24)

Richard O. Walker, Jr., a member of the firm of Abbott, Merkt & Company since 1948, has been appointed vice president of the firm. Currently Mr. Walker is in charge of design and construction at the Monmouth Shopping Center, being built by the Massachusetts Mutual Life Insurance Company in Eatontown, N. J. He recently served in the same capacity on the Garden State Plaza Shopping Center in Paramus, the largest shopping center in the East.

Wilmer Z. Kline, after many years, has retired as director of design in the Public Works Office of the Fourth Naval District, with headquarters in Philadelphia. He is succeeded by **Leo Levantine,** who prior to his promotion was manager in the district's design division. Mr. Kline is a retired captain in the Naval Reserve of the Civil Engineer Corps.

Don Lee, soils and paving engineer for the Federal Aviation Agency for the past eighteen years retired on August 31. Previously, he had been associated with the Portland Cement Association, the Texas Highway Department and the Associated General Contractors. His home address will be 501 Brookside Drive, Bryan, Tex.

John W. Bunker recently reported to the northern Porter County (Indiana) plant site of the Midwest Steel Corporation at Michigan City as chief construction engineer. Mr. Bunker goes to the Indiana plant from the Atlas Cement Company, New York City, where he was project development engineer for all the firm's plants.

Recent Books

(Continued from page 118)

structure and load. The solutions allow almost limitless variation in the shape or cross section of members, and can be used in steel, concrete, and wood design. (By Valerian Leontovich. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 472 pp., bound. $20.00.)

Law for Engineers and Architects

Fourth Edition

Discusses those branches of the law which bear most directly upon the engineering profession, and illustrates by means of cases how the courts have applied the rules stated in the text to concrete situations involving engineers, architects, builders, and owners. The first half of the book is devoted to contracts, while the second half is concerned with the law of agency, mechanics' liens, workmen's compensation, and property. Standard forms of construction contracts, invitations to bidders, subcontracts, contracts between architect and owner, etc. are given in the appendix. (By Lawrence P. Simpson. West Publishing Company, St. Paul 2, Minn., 1958. 506 pp., bound. $7.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or microfilm a copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

A Primer of Programming for Digital Computers

An introduction to electronic computing for scientists and engineers who are planning to use electronic computers as tools of research. Although the IBM Type 650 is used in the examples given, the general techniques described are applicable to practically all stored-program computers. Topics discussed include the approach to simple problems; loops and branches; flow diagrams, subroutines, and the program library; testing programs; automatic programming; arithmetic instructions in machine language and SOAP. (By Marshal H. Wrubel. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 230 pp., bound. $7.50.)

River Pollution

Chemical Analysis

The present volume constitutes an expansion of chapters 9 and 10 of the author's previous work "Aspects of River Pollution", and provides a chemical background for analytical methods used in river pollution. Topics discussed are physical and chemical methods; dissolved oxygen and oxygen demand tests; combined nitrogen; sulphur compounds; alkalinity, acidity, free carbon dioxide, free chlorine, chloride, fluoride; metallic contaminants; various carbon compounds. (By Louis Klein. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y., 1959. 206 pp., bound. $6.00.)

Statically Indeterminate Structures

Presents the approximate analysis of statically indeterminate structures using statics and the principles of deflected structures. Detailed procedures of sketching deflected shapes and their analysis are thoroughly developed, and are followed by the approximate analysis of structures under lateral loads for both rigid-frame and shear-wall structures. Elastic and plastic analysis procedures receive an integrated treatment, and the same type of basic technique is used in both types of analysis. Also included is information on

(Continued on page 124)

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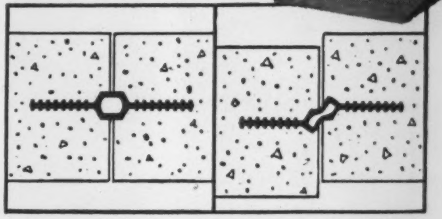

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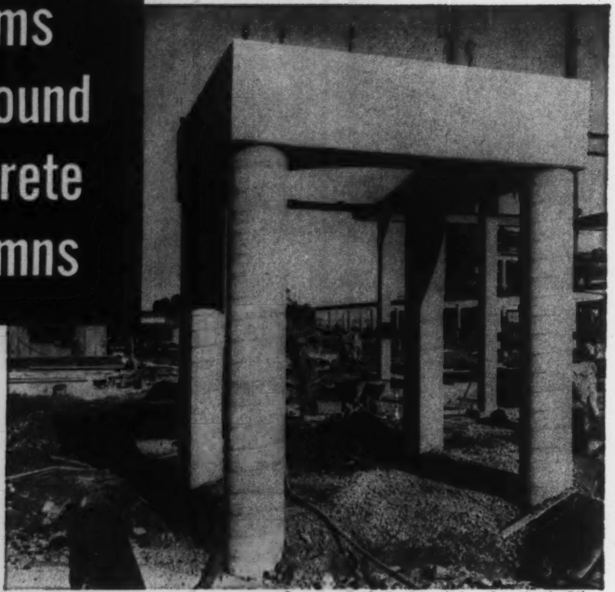

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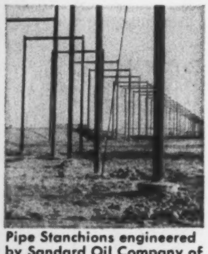

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4221

New in Education

(Continued from page 116)

Engineering curricula . . . *Clarkson College of Technology* has inaugurated a new four-year undergraduate program. Designed specifically to prepare young men to enter the field of Construction Distribution, the course will lead to the degree of Bachelor of Science . . . For the first time since 1914 *Columbia University's School of Engineering* will open its doors to freshmen. A small group of highly qualified high school graduates will be admitted to the new four-year course. Until now, students have been required to have at least two years of work in an undergraduate liberal arts college before spending two years in the engineering school.

Grants for education. . . A $55,000 grant to finance a three-year study of atmospheric pollution and diffusion has been made to J. E. Cermack, A.M. ASCE, associate professor of civil engineering at *Colorado State University* by the National Institutes of Health, U.S. Department of Health, Education and Welfare.

Building for research . . . *Clemson College* boasts a new $1¼ million building which houses its department of civil engineering, headed by Walter L. Lowry, M. ASCE, and its department of engineering mechanics, headed by Dr. Robert Moorman. The new facilities will provide for sponsored research, a graduate program, and a broadened undergraduate curriculum.

Haven for scholars . . . The $200,000 Center for Research in Engineering Science at the *University of Kansas* at Lawrence, will be headed by Dean John S. McNown, F.ASCE, of the university's School of Engineering. The center which is being financed by gifts and grants is envisioned as a midwestern counterpart to the Institute for Advanced Studies at Princeton, since its principal purpose is to provide a place for scientists to study, think and discuss problems among themselves.

Recent Books

(Continued from page 123)

the plastic collapse of assemblies, the efficiency of structural forms, and the relationship of analysis to design and economic studies. (By Jack R. Benjamin. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 350 pp., bound. $11.00.)

Surveying

Fourth Edition

In addition to the basic principles of surveying, this volume provides sufficient information to develop a sound working knowledge of special surveying topics such as photogrammetry and the use of accurate design topographic maps for determining earthwork quantities. In this edition changes have been made to bring the text up to date, and there are also major changes in the presentation. This is particularly true in the case of modern surveying equipment and practices. (By Harry Bouchard and Francis H. Moffitt. International Textbook Company, Scranton 15, Pa., 1959. 664 pp., bound. $10.50.)

Wiley BOOKS *A FALL CHECKLIST*

1. AMERICAN CIVIL ENGINEERING PRACTICE

Editor-in-Chief: ROBERT W. ABBETT, *Abbett-McCarthy-Stratton, Engineers*. The basic reference, presenting principles, procedures, and the data of modern practice, with illustrations from current works. *Vol. I, 1956. 1026 pages. $15.00. Vol. II, 1956. 917 pages. $15.00. Vol. III, 1957. 1280 pages. $25.00*

2. AN INTRODUCTION TO THE DYNAMICS OF FRAMED STRUCTURES

By GROVER L. ROGERS, *Virginia Polytechnic Institute*. The first of its kind specifically for the structural engineer. Using mathematics as a real working tool, the first part is based on the theory of matrices, and the second part on the theory of orthogonal functions. *1959. 358 pages. $10.25*

3. PRINCIPLES OF PAVEMENT DESIGN

By E. J. YODER, *Purdue University*. Presents principles and design methods for flexible and rigid pavements. Clarifies many practices that have been adopted to meet loading and environmental conditions. Also covers methods of evaluating performance and types of failure. *1959. 569 pages. $13.25*

4. AIR POLLUTION CONTROL

By W. L. FAITH, *Air Pollution Foundation*. All important factors, including: effects of pollution; relation of weather; air contaminants, their sources; measurements; auto exhaust and radioactivity; legal aspects. A non-technical treatment. *1959. 259 pages. $8.50*

5. GROUND WATER HYDROLOGY

By DAVID K. TODD, *University of California*. First new treatment in the U. S. for over 20 years. Stresses the fundamentals, especially in the sections on hydraulics, well construction, and location methods. Includes a chapter on research methods. *1959. 336 pages. $10.75*

6. BASIC GEOLOGY FOR SCIENCE AND ENGINEERING

By EDWARD C. DAPPLES, *Northwestern University*. For the practicing engineer, the material is organized along these lines: 1) observation and gathering data; 2) classification of data into graphic and tabular forms so as to determine the existence of relationships between properties; 3) interpretation of relationships in order to form workable generalizations. *1959. 609 pages. $9.50*

7. PLASTIC DESIGN OF STEEL FRAMES

By LYNN S. BEEDLE, *Lehigh University*. Gives principles and methods that are the basis for plastic design and shows how they are used in the solution of practical building frame design problems. *1958. 406 pages. $13.00*

8. MECHANICS, Second Edition

By J. L. MERIAM, *University of California*. A thorough revision of the two-volume work, to clarify, strengthen, and extend its range of applicability. Many new examples. PART I: STATICS — chapter on beams replaced by pertinent articles in other sections, and material on fluid statics completely rewritten. *1959. 393 pages. $5.00*

PART II: DYNAMICS — kinematics rewritten to separate absolute and relative motion, and the equation of motion as a differential equation gets increased stress. *1959. 420 pages. $5.00*
Combined Edition. *1959. 746 pages. $8.75*

9. REINFORCED CONCRETE FUNDAMENTALS

With Emphasis on Ultimate Strength. *By* PHIL M. FERGUSON, *University of Texas*. An up-to-date introduction, including pertinent information on the physical behavior of reinforced concrete members. *1958. 604 pages. $9.50*

10. ENVIRONMENTAL SANITATION

By JOSEPH A. SALVATO, JR., *Rensselaer Co. Health Dept*. Stresses practical application of sanitary theory and principles to the smaller community. Includes planning, design, construction, maintenance, operation, and administrative details. *1958. 660 pages. $12.00*

11. MATERIALS AND METHODS OF ARCHITECTURAL CONSTRUCTION

Third Edition. By HARRY PARKER, *the late* CHARLES M. GAY, *and* JOHN W. MacGUIRE, *University of Pennsylvania*. About 70% rewritten to include new materials, specifications, and types of construction. Gives new safe load tables for present-day working stresses. *1958. 724 pages. $12.00*

12. ADVANCED MECHANICS OF FLUIDS

Edited by HUNTER ROUSE, *State University of Iowa*, with 9 contributors. Stresses the analytical techniques of research, and includes accounts of latest research and developments in the field. *1959. 444 pages. $9.75*

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13. THE TECHNICAL WRITER

By J. W. GODFREY and G. PARR. *1959. 340 pages. $8.50*

14. NOMOGRAPHY

Second Edition. By A. S. LEVENS. *1959. 296 pages. $8.50*

15. TECHNICAL REPORT WRITING

By J. W. SOUTHER. *1957. 70 pages. $2.95*

16. SCIENTIFIC RUSSIAN

By G. E. CONDOYANNIS. *1959. 225 pages. $3.50*

17. PRESTRESSED CONCRETE

By R. H. EVANS and E. W. BENNETT. *1958. 294 pages. $10.00*

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2 ADMIXTURES FOR CONCRETE

Sika Chemical Corp.—Some of the products described in this 8-page catalog include Plastiment retarding densifier for increased strengths and improved workability; Igas Joint Sealers for long lasting, water-tight construction joints, Rugasol for exposing aggregates for construction joints or architectural effects; quick setting products for stopping leakage; and membranes and coating.

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3 AERIAL MAPPING

Aero Service Corporation—Literature covering economical applications of varied aerial mapping services is offered. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, and plastic relief maps. Services discussed are used in highway design, plant engineering, industrial development, city planning, and tax maps.

4 ALUMINUM GRATING

Borden Metal Products Co.—A brochure by way of diagrams and photos illustrates the properties and use of aluminum floor gratings. Also shown are tables of their specifications. A description of safety grating and aluminum safety steps is featured.

5 ALUMINUM GRATING

Kerrigan Iron Works, Inc.—An 8-page catalog on three types of aluminum grating, Roll-Lock, Riveted and Pressure-Locked, is available. It contains load tables and engineering data on all types and in-use illustrations or photographs. Lightweight, non-magnetic, noncorrosive, aluminum grating has no maintenance cost and its high strength insures many years of service.

6 ALUNDUM AGGREGATE

Norton Co.—This 8-page booklet discusses the two features of the company's Alundum floors products—walking safety (wet or dry) and exceptional durability. Sizes, specifications, and photographs are included in this brochure.

7 APPLIED POLYMER CHEMISTRY

Thiokol Chemical Corporation—Issues of the company's publication, "Thiokol Facts", are offered. Volume 4, No. 2 contains articles on Plastic Tooling, Thiokol Liquid Polymer Enables a New Concept in Fiber Glass/Epoxy Pipes, and Flowing Modern Architectural Design Creates New Challenge For Elastomeric Sealants. Volume 4, No. 4 includes The Expanding Sealant Market and Producing Urethane Ducks.

8 ASPHALT LINER MANUAL

W. R. Meadows, Inc.—announces the availability of a "Hydromat" Asphalt Liner Manual. The "Hydromat" Manual fully describes applications and contains installation information, necessary technical engineering data and specification information. This is not a sales catalog, but strictly a Technical Data Manual.

9 AUTOCOLLIMATING THEODOLITE

Kern Instruments, Inc.—Information is available on the Autocollimation Eyepiece, which when attached to the DKM2 1-sec Theodolite, becomes an integral part of the instrument. Total telescope magnification is 23x, working distance up to 100 ft indoors. The light source is an easily replaceable standard 3-V or 6-V bulb. The instrument can be used for normal surveying without removing the eyepiece by simply switching off the light which illuminates the reticule.

10 AUTOMATIC GATES

Thompson Pipe & Steel Co.—This catalog illustrates and explains 3 devices which control upstream and downstream water levels and flow without usual floats and supervision. On-the-job photos and diagrams show the many irrigation and water-works applications. These gates are made on the widely-adapted Neyrpic principle.

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CATALOG DIGESTS

11 AUTOMOBILE CATALOG

Oldsmobile, Division of General Motors Corp.—A colorful catalog will be available soon on the company's 1960 automobiles. It will show the new styling and will include specifications.

12 AUTOSET LEVEL

Eugene Dietzgen Co.—A 5-page brochure describes the Watts Autoset Level. This latest two-color bulletin not only describes the uses to which this level can be put, but also gives complete technical data and specifications.

13 BETHLEHEM SLABFORM

Bethlehem Steel Co.—The advantages and placing directions for using Bethlehem Slabform, a solid-steel centering for steel-joist and poured-slab construction, is described in Bulletin F 683.

14 BETTER WATER SERVICE

Johns-Manville Corp.—An 84-page booklet written for water utility superintendents, engineers and public officials, shows the benefits of good water service to a community; how to evaluate your water system; how to turn that evaluation into improved service; and how to arouse the public to action.

15 BOILERS, BOILER-BURNER UNITS AND STOKERS

The James Leffel & Co.—Complete descriptive and specification data on rugged, reliable Scotch-type boilers for oil, gas or coal firing and automatic underfeed stokers for use with Scotch-type boilers is given in richly illustrated 28-page Bulletin 236. Descriptive literature on outstanding installations of Leffel boilers and boiler-burner units will be enclosed.

16 BORINGS

Raymond International Inc.—A booklet "Subsoil Investigations for Foundations" Catalog B-7 explains the reason for subsoil investigations, what Gow borings are and how they are made, and the results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

17 BRIDGE BEARINGS & PLATES

Lubrite Div., Merriman Bros., Inc.—This literature provides complete information about Lubrite Expansion Plates and Bushings with typical suggested design details and technical data. Lubrite Bearings are completely self-lubricating and do not require periodic maintenance or servicing. The bearings are applicable to steel and concrete structures. Special design provides for rotation of beam, due to deflection, as well as for the normal therman expansion and contraction of the span.

18 BRIDGE DECK VIBRATING SCREED

Stowe Manufacturing Co.—A technical bulletin (#587) has been published on the advantages and uses of vibrating screeds for bridge decks. It contains detailed information on the latest techniques for striking off concrete surfaces by vibratory screeding. Illustrations are also included.

19 BRIDGE FLOORING

American Bridge Division—This 32-page booklet contains complete engineering drawings and design data for all available I-Beam-Lok sizes, plus detailed coverage of Specifications, including the type of steel, erection, fabrication, painting, field assembly and welding. A brief discussion of composite T-beam action between I-Beam-Lok flooring and steel stringers is also included.

20 BRIDGES

The Ingalls Iron Works Co.—This booklet features information on bridges by Ingalls—from detailing to fabrication to erection. Photographs of some of the bridges on which the company has worked are included.

21 BUILDING CONSTRUCTION HANDBOOK

McGraw-Hill Book Co., Inc.—Free descriptive literature on this 850-page handbook on modern building design and construction methods and data is now available. Written by Fred Merritt, it covers building materials; stresses in structures; soil mechanics and foundations; concrete, structural steel, and other constructions; roofs; acoustics; insulation; air conditioning; plumbing; costs; construction management; and specifications.

22 BUILDING PRODUCTS

Richmond Screw Anchor Co., Inc.—A complete line of building specialties for concrete construction is illustrated in this 8-page bulletin. Included are cast iron and malleable threaded inserts, malleable adjustable inserts, peerless wedge inserts, all size inserts, continuous inserts, anchor slot, corrugated wall ties, anchor bolts, block mesh, wale holders and other items used in building construction.

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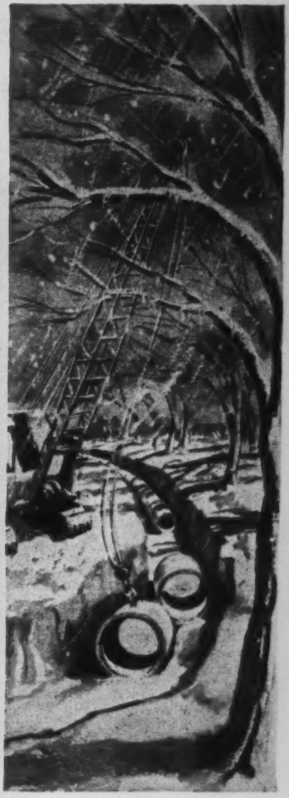

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CATALOG DIGESTS

23 BUILDING SAVERS

L. Sonneborn Sons, Inc.—A 16-page brochure of building construction and maintenance data covering the company's water-proofings, floor treatments, admixtures and protective coatings. The product descriptions include definitions, directions, advantages, coverage and specifications. Known as Building Savers, these quality products are the tested solutions to your building construction and maintenance problems.

24 CARPULLERS

Superior-Lidgerwood-Mundy Corp.—A 24-page, 2-color bulletin C-616 "Carpullers for Easy Moving Rolling Loads" is available, with descriptions, illustrations, data, tables, and specifications for Carpuller requirements. Illustrates and describes the Electric Capstan Carpuller for car moving, barge moving, pipe bending or any haulage of similar nature; also Tugmore Capstans, Horizontal Head type Capstan Carpullers, Drum Type Carpullers, Friction Drum Type Carpullers, etc.

25 CAST IRON PIPE

U. S. Pipe & Foundry Co.—An 8-page booklet on centrifugally cast, Tyton Joint pipe for water or other liquids. The newly developed Tyton Joint is simple, sturdy, and tight. Illustrations show details of joint and method of assembly.

26 CAST IRON PIPE, HYDRANTS AND VALVES

R. D. Wood Company—A general catalog is available providing full details of weights and dimensions of "sand spun" cast iron pipe and cast iron fittings. This catalog also features fire hydrants, gate valves and other products manufactured by this company.

27 CEMENT LININGS

Centriline Corp.—The Centriline Process for cement mortar lining steel, cast iron, concrete and terra cotta pipelines in place and which has been available in the diameters 16 in. to 144 in. can now be used in pipelines as small as 4 in. in diameter. This adaptation of the Centriline Process for small pipelines eliminates the necessity for excavations at laterals and corporation cocks and is fully described in this illustrated catalogue.

28 CHEMICAL PROPORTIONING PUMP

B-I-F Industries, Inc.—Information is available on an electrically driven, positive displacement chemical proportioning pump, the Model 1210 Chem-O-Feeder, which features a corrosion-resistant transparent plastic head, Hypalon diaphragm and check valves, and a straight-through flow design. The pump is ideal for the water treatment field, for industry, swimming pools, chemical plants and municipalities.

29 CIVIL ENGINEERS' BOOK CLUB BULLETIN

McGraw-Hill Book Co., Inc.—The official guide reporting new books of professional interest and recommending various publications worthy of bookshelf space in the civil engineer's library is available. A single issue is free.

Please give your complete address.

30 CLAD STEEL BRIDGE BEARING PLATES

Lukens Steel Company—A discussion of the development of Lukens clad steel for bridge bearing plate applications together with a description of types of plates presently available.

31 CLARIFLOW

Walker Process Equipment Inc.—Bulletin 6-W-46 gives the background and theory of the Clariflow and its application in water treatment. Designed for either circular, square or rectangular basins, the unit combines zones for chemical mixing, flocculation, settling and sludge removal to provide high capacity in a relatively small basin as compared to the usual layout for these processes. Illustrations depict some of the hundreds of installations. Specifications and layouts are included.

32 CLAY PIPE

National Clay Pipe Manufacturers, Inc.—This 48-page fully illustrated brochure entitled "The Story of Clay Pipe" contains a historical record of clay pipe, its contribution to America from the beginning of the 20th century to the present, and a look into the future of American homes, industries and communities.

33 COFFERDAMS

Spencer, White & Prentis, Inc.—"Cofferdams," by Lazarus White and Edmund Astley Prentis is a trusted source-book covering actual design and construction of cofferdams as well as the theoretical features. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

34 COLD WEATHER CONCRETING

Sika Chemical Corp.—Complete information on accelerating setting of concrete during cold weather is available. Booklet includes test data, specifications and technical information on Sikacrete accelerating densifier.

35 COMBINATION FINISHER-FLOAT MACHINE

The Heltzel Steel Form & Iron Co.—An illustrated brochure presents the Flex-Plane Gas-Electric Combination Finisher-Float Machine for concrete highway and airport paving. One machine combines both transverse finishing and longitudinal float operation into one. The gas-electric drive allows the operator to select the desired ratio of screed speed to machine speed to compensate for any mix or slump.

36 COMPACTION METHODS BOOKLET

The Galion Iron Works & Mfg. Co.—Booklet No. SR-31, an informative, well-illustrated, non-technical, 16-page pamphlet covering all types of rollers and other compaction equipment has been published. This treatise will be especially helpful to anyone who has previously had no opportunity to study the subject of soils and materials compaction, the problems encountered, and the application of the various types of equipment available.

37 CONCRETE FORMING

Universal Form Clamp Co.—A new 16-page booklet on items of interest to contractors and engineers on concrete forming is available without charge.

38 CONCRETE FORMING SYSTEM

Economy Forms Corporation—A catalog with pictures is offered showing a complete forming system available to contractors on a purchase basis. The easy adaptability of these forms to all types of form work, plus engineering layout service on each new project, together with a complete steel form good for a lifetime of service makes the new EFCO form an attractive investment for the large and small builder. Also available, a four-page leaflet covering forms for prestressed or precast concrete beams, etc.

39 CONCRETE GUNNING EQUIPMENT

Air Placement Equipment Co.—A 16-page booklet is available on concrete gunning equipment. Through photographs, it shows different types of concrete construction jobs where the company's gunning equipment may be used. Some examples are railroads, mines, swimming pools, grain elevators and refineries.

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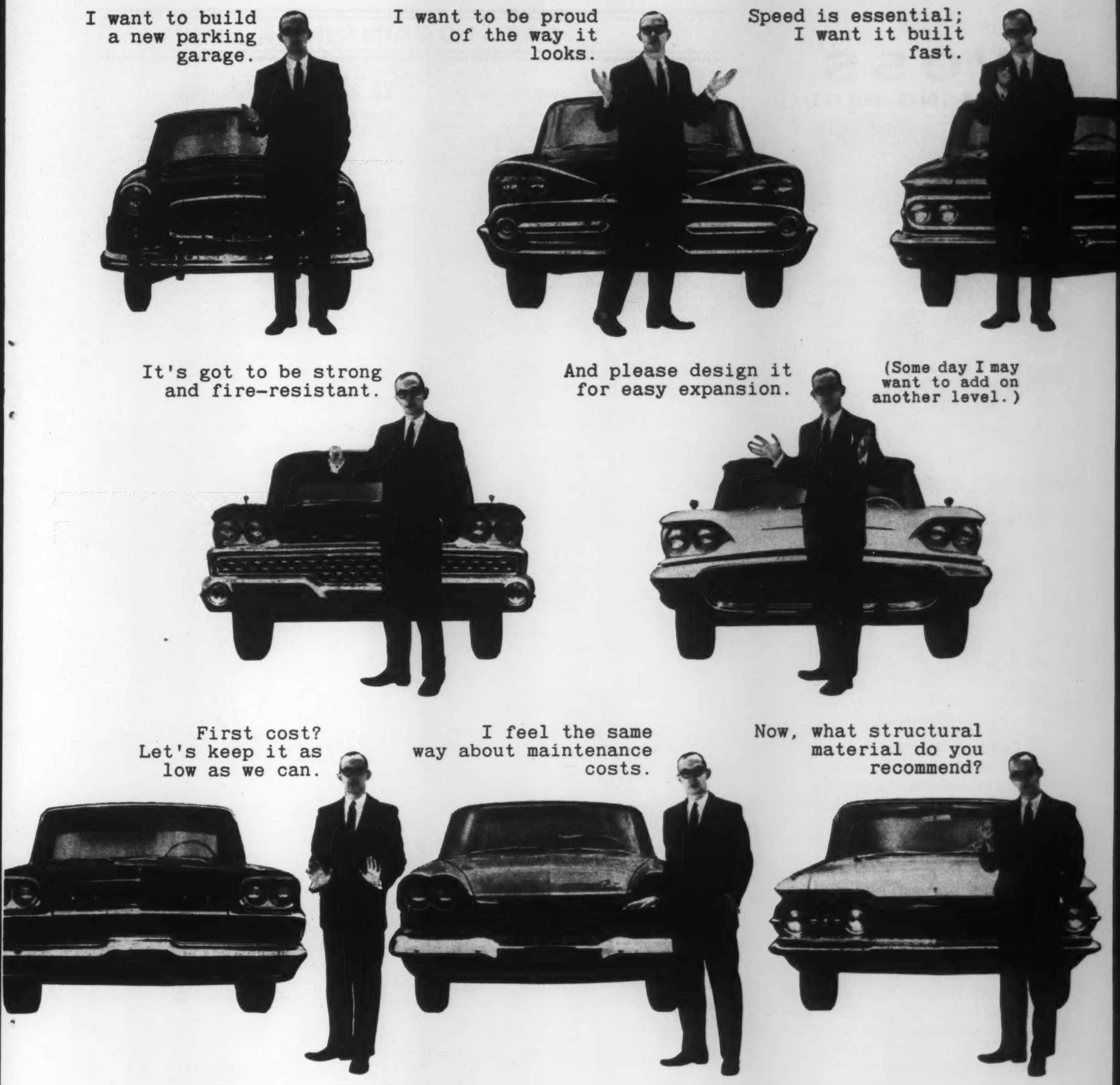
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CATALOG DIGESTS

40 CONCRETE PIPE COUPLING—AMBAND

American-Marietta Company—A pamphlet on Amband fiber glass reinforced resin couplings used with double spigot, rubber gasketed concrete pipe. To be used for pressure heads up to 125 feet, for infiltration as low as 100 inch-gallows per mile per day. Amband couplings withstand corrosive action.

41 CONCRETE SAWS

The Concut Sales Inc.—Bulletin ES 5902 covers pertinent design features and specifications on the Concut C-209 and CP-209 Concrete Saws. Both units are medium size 20 hp units with a capacity for large and difficult jobs. Also available is information on the CP-369 Concrete Saw, featuring a 36 hp engine and alternate center or right side blade cutting position. Bulletin ES 5901 describes the Concut C-99 Concrete Saw, a lightweight 9.2 hp unit designed for industrial plant maintenance work and such requirements as encountered by municipalities, utility companies and electrical contractors.

42 CONCRETE TESTING EQUIPMENT

Forney's Inc., Tester Div.—A catalog is offered describing a complete line of plant and jobsite testing machines for cylinders, cubes, beams, blocks, pipe and tile. Capacities range from 0 to 250,000 lb to 0 to 500,000 lb. Also described is a complete line of collateral equipment including the Los Angeles Abrasion Machine, cube and beam molds, slump cones, and cylinder capping apparatus.

43 CONCRETE TO CONCRETE BONDING

Thiokol Chemical Corp.—Some of the subjects discussed in this brochure are: What is Liquid Polymer?; Concrete Adhesives; Overlays; Remedial Patching; and Anti-Skid Surfacing. The booklet is illustrated. Also available is a booklet entitled "Liquid Polymers LP-2 and LP-32."

44 CONCRETE WATERSTOPS

Water Seals, Inc.—Labyrinth^{R} Waterstops are manufactured of polyvinyl plastic, which helps maintain a constant, strong, watertight bond between concrete joints. A catalog describes the convenient features of Labyrinth^{R} Waterstops, including those which render it resistant to age, chemical and weathering changes. Blueprint type specification drawings include the Labyrinth, Flextrip, Cellular and Dumbbell waterstops in their various sizes. A table lists the recommended joint application and water head for each size and kind of waterstop.

45 CONCRETING IN DIFFERENT WEATHER

Alpha Portland Cement Co.—Two folders are available entitled "Cold Weather Concreting" and "Hot-Weather Concreting". Both give tips for best results through pictures and captions. Precautions are listed in both booklets.

46 CONSOLIDATED TESTING APPARATUS

Soiltest, Inc.—A 4-page bulletin is available on consolidation test apparatus. Illustrated and described is the Soiltest Levermatic Consolidation Device, which loads up to 20 tons on a 2½ in. dia specimen. Other frame mounted lever loading consolidation units are also shown.

47 CONSTRUCTION EQUIPMENT

International Harvester Co.—Some of the construction equipment contained in this brochure includes: T-6 Gasoline Crawler Tractor; TD-9 Diesel Crawler Tractor; TD-24 Gear Drive Diesel Tractor; Hydraulic Bulldozers; Direct-Lift Cable Bulldozers; and Tractor-Drawn Four-Wheel Scrapers. Photographs and specifications are included.

There are 242 Digest items on pages numbered 126 to 151. Read all items for the literature of interest to you.

48 CONSTRUCTION EQUIPMENT

Massey-Ferguson Industrial Division—Information is available on the Davis Deluxe Loaders for Work Bull 202 and 204 tractors; the Davis Backhoe for Work Bull 202 and 303; Work Bull 1001 Multi-Purpose Tractor Loader; and Work Bull 204 Industrial Tractor. All of the pamphlets are in color and are fully illustrated.

49 CONTRACT MANUFACTURING

Goslin-Birmingham Mfg Co., Inc.—Bulletin 708-1 offers information on contract manufacturing and service. A list of the products fabricated by the company includes steel casting, iron castings, stress relieving, lock and dam equipment, large cast iron pipe and fittings, heavy machine work, plate fabrication, and custom machinery and equipment.

50 CONTRACT PUMPING

American Dewatering Corp.—A well illustrated catalog describing the predraining of many construction projects of typical and unusual interest. Outlines the services and benefits of contract pumping in which this company specializes.

51 COPYFLEX DIAZOTYPE COPYING PROCESS

Charles Bruning Co., Inc.—A 12-page illustrated booklet describing the Copyflex diazotype copying process is available. This booklet describes the concept of the process as related to simplification of paperwork in business operations. The method of using reproducible copies, removing information from originals and copies, combining Polaroid Land Photos and text to produce illustrated copies, are just a few of the techniques illustrated and described step by step in the booklet.

PHOENIX BRIDGE
COMPANY

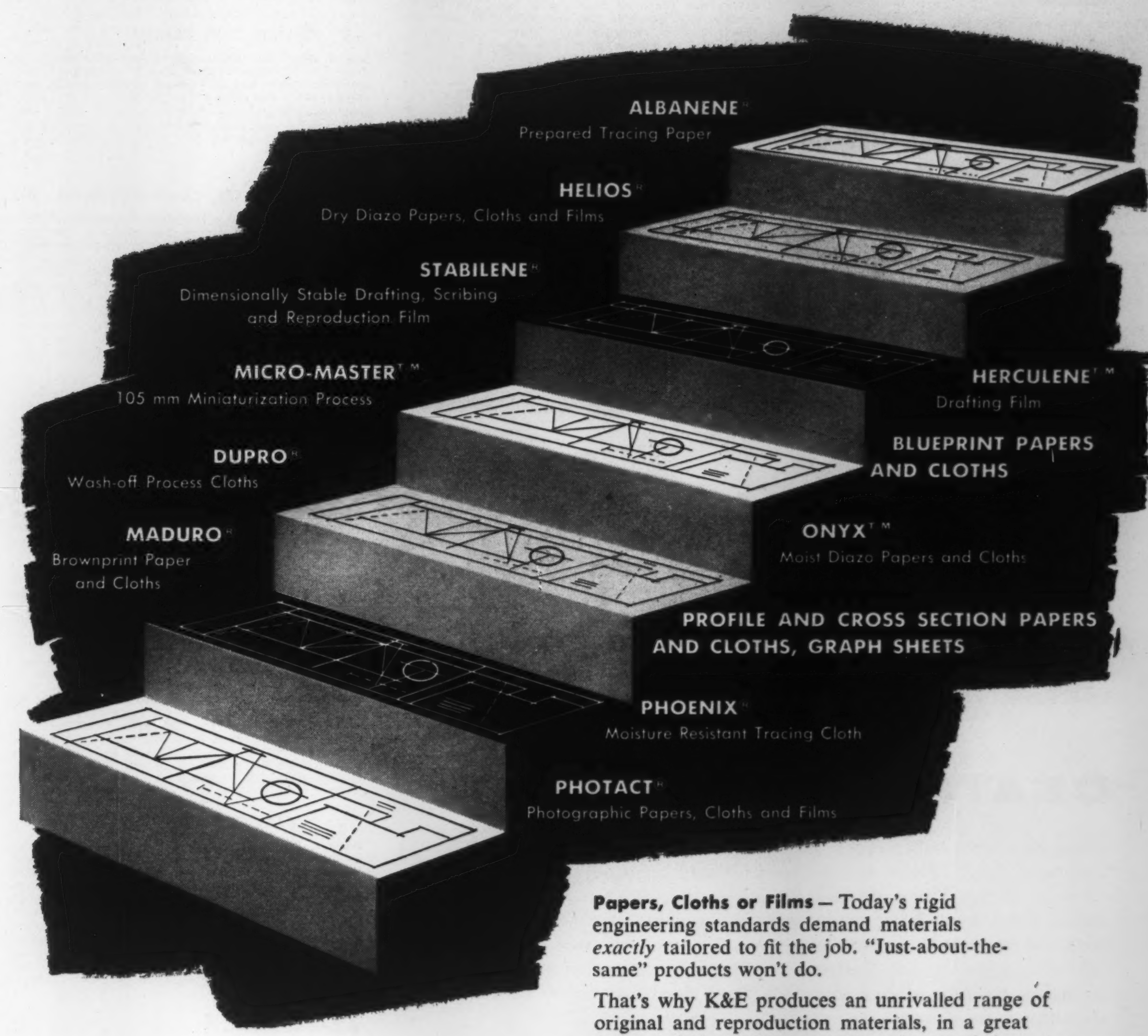
Engineers
Fabricators
Erectors

Structural Steel
BRIDGES and BUILDINGS

General Office
and Shops

PHOENIXVILLE, PA.

Use the right material
every step of the way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Papers, Cloths or Films – Today's rigid engineering standards demand materials *exactly* tailored to fit the job. "Just-about-the-same" products won't do.

That's why K&E produces an unrivalled range of original and reproduction materials, in a great variety of sizes, shapes, surface characteristics and working properties to choose from.

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CATALOG DIGESTS

52 COPYFLEX DIAZOTYPE REPRODUCTION PROCESS

Charles Bruning Co., Inc.—A 12-page illustrated booklet describing the Copyflex diazotype reproduction process is now available. The booklet explains the various types of direct-positive prints possible with Copyflex, including black-line or color-line prints on white or tinted stock; multi-color films for projection and overlays; translucent duplicate originals; dimensionally stable film and glass cloth prints; and reflex prints on translucent film.

53 CRAWLER TRACTORS

Allis-Chalmers Mfg. Co.—The HD-16 crawler tractors with dual range constant mesh transmission and hydraulic torque converter drives are featured in Catalog MS-1318. Both models are powered by the new 150 net hp 16000 engine. Engine and tractor specifications and a cutaway of the tractor are included.

54 CRAWLER TRACTORS

The Eimco Corp.—Engineering features, specifications and an explanation of "Unitized Stress-Flow Construction" used in the Eimco 103 series of 100 hp tractors is contained in an 8-page brochure. Bulletin L-1073. The 4-speed "Quadra-Torque" transmission, which allows immediate speed changing by power shift, and fully independent control of each track, a self-cleaning air cleaner, and other features are explained. Other tractor catalogs available are L-1074, L-1076 and L-1077.

55 DENSION CORE BARREL

Acker Drill Co., Inc.—offers free of charge, a copy of Bulletin 1100, which describes the Dension Core Barrel. Acker has obtained exclusive manufacturing rights to the tool. The brochure illustrates and describes how the core barrel operates. The cutaway drawing of the barrel shows all of the important operational features.

56 DEPTHOMETER, CAMERA LOCATOR

Bludworth-Marine—Literature describing the single transducer survey depthometer ES 130, which is portable, weighs under 40-lb and performs with great flexibility and precision, is available. Also provided is information on an underwater TV camera with a continuous picture on monitor screen on boat or land, with depths to 180-ft; and a metal locator which pinpoints ferrous and non-magnetic metals in fresh and salt water. Pressurized to depths up to 160-ft, this locator weighs 1½-lb submerged.

57 DESIGN MANUAL

W. R. Meadows, Inc.—has prepared a manual entitled "Design Techniques for Controlling Moisture in Building Structures." This manual, prepared by a firm of technical engineering writers, was originally planned to sell for $1.00 per copy. However, as this problem is of vital interest to all in the construction industry, this company will now send a free copy to all architects, engineers and builders who desire a copy for their file.

58 DETERMINING EARTHWORK QUANTITIES

Fairchild Aerial Surveys—The brochure shows and describes the latest equipment used for taking cross sections and profiles for highway and other projects where earthwork quantities are involved. The equipment operates with both Fairchild's Kelsh Plotters and C-8 Stereoplanigraphs. Once the aerial photography has been flown, and necessary control surveys completed, profiles and cross sections may be taken from as many alternate routes as desired in the office. Data is simultaneously punched on computer cards and automatically typed in tabular form.

59 DIGITAL COMPUTER

Bendix Computer Div., Bendix Aviation Corp.—A 6-page illustrated bulletin describes highlights of the Bendix G-15 digital computer with particular emphasis on the magazine-loaded photo tape reader which is offered as standard equipment. Also included are descriptions of Pogo and Intercom 1000 programming systems; accessory punched card, magnetic tape and paper tape equipment; and several purpose devices and G-15 specifications.

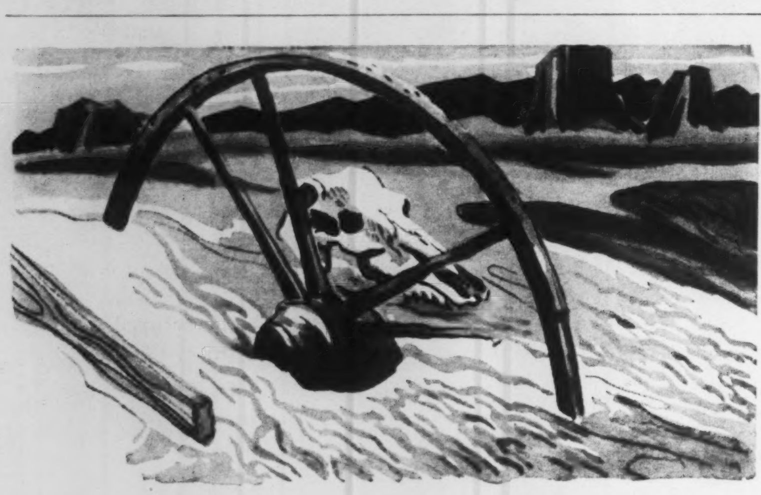
60 D-O AERATOR

Dorr-Oliver Inc.—A 4-page, two-color bulletin entitled, "The D-O Aerator", describes the development, design and advantages of this improved method for supplying oxygen demands in the activated sludge process. Also included in Bulletin No. 7316 are cutaway wash drawings of typical Aerator installations and activated sludge flowsheet in which the unit is employed.

Turn to page 126 and order your literature.

61 DORRCLONE DESANDING SYSTEM

Dorr-Oliver Inc.—The availability of a 4-page, two-color brochure entitled, "The DorrClone Desanding System", has been announced. This brochure describes the design, operation and performance of the new system for desanding water supplies. Also included in Bulletin No. 2507 are an installation photograph, schematic flowsheet of the system, cutaway wash drawing of the DorrClone classifier and operating data.



DEATH in the DESERT

If you have ever seen a desert or picture of a desert, you realize it is a scene of death. There may lie the bleached bones of an animal or a human being. There are no trees, no vegetation. The soil may be rich in plant food, but nothing grows. It is proof that water is the lifeblood of everything that grows—animal or vegetable.

It is an historic fact that past civilizations have risen and fallen according to their ability to satisfy their need for water. Water's abundance in America in the past is now deceiving. Not that the U. S. is turning into an arid desert, but the problem is inadequate water distribution facilities. U. S. water works improvements have not kept step with the phenomenal increase in population and industrial expansion, which means increased demand for water.

U. S. water works officials know this situation and are trying to solve it, but they need better public support.

This Series is an attempt to put into words some appreciation of the water works men of the United States.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF W WALWORTH

CATALOG DIGESTS

62 DRAFTING PENCIL

J. S. Staedtler, Inc.—The leaflet "Won't Smear on Mylar!" gives information on Mars Duralar, the drafting pencil especially developed for work on the matte-surface Mylar tracing films. It will not smear, keeps its point, erases cleanly, reproduces perfectly. Drawings can be cleaned with soap and water, and microfilm without loss of detail. Duralar is available in 5 special new degrees of hardness (K1 to K5) in pencils, leads; Duralar lead holder is also available.

63 DRAIN GRATES

Irving Subway Grating Co., Inc.—A four-page, two-color folder illustrating the use of open mesh steel flooring as drain grates is available. The folder contains photographic illustrations and shows typical uses of drain grates. There are engineering drawings of the various types and complete technical data to facilitate estimates and specifications.

64 DREDGING EQUIPMENT

Posey Iron Works, Inc.—This catalog contains photographs of drag heads, combination wye branch and gate valve, fabricated spuds, pontoon and shore pipe, pressed steel plate ball joints with abrasion resisting steel plate liners, and hydraulic dredge hull. The company offers a complete selection of pipe and other dredge fittings to meet every dredging need. All units that are subject to abrasion are fabricated from high carbon—high manganese special dredge pipe steel or abrasion resisting steel.

65 EKTRON DETECTOR

Eastman Kodak Co.—A 24-page booklet giving an analytical description of the process and material is included in the Ektron Detector literature. Diagrams and graphs are included in the brochures.

66 ELEVATED TANKS

Pittsburgh-Des Moines Steel Co.—Details of the several different types of elevated steel tanks, including capacity, ranges, tank dimensions, and other factors to be considered in the selection of storage tanks. Also available, 4 pages of pictures and discussion about flat bottom water storage.

67 ELEVATED WATER STORAGE TANK

Graver Tank & Mfg. Co.—A handsome booklet in full color describing a new design for elevated water storage tanks is offered. Besides its operational features, the Aquatore has a wholly new and distinctive appearance, according to the manufacturer. Suited to capacities from 300,000 gal to 3 million, it is the first advance in elevated tank design in nearly a quarter century, the company states.

68 ELLIPTICAL CONCRETE PIPE—LO-HED

American-Marietta Co.—This pamphlet covers elliptical Lo-Hed Reinforced Concrete Pipe for culverts and sewers. Specifications are given for the complete range of sizes from the equivalents of round pipe 18-in. I. D. through 144-in. I. D. Illustrations show results of pressure tests and installations of Lo-Hed pipe being made on various types of jobs.

69 ENGINEERING BOOKS

The Ronald Press Co.—A descriptive brochure on 29 up-to-date, authoritative books is offered. Of prime interest to civil engineers are books covering such subjects as: power plant theory and design, air conditioning, soils engineering, substructure analysis and design in metals, linear structural analysis and statically indeterminate structures.

70 EPOXY COMPOUNDS

Sika Chemical Corp.—The folder describes a variety of construction applications of new thermo-setting plastics. These materials exhibit physical properties exceeding those of most comparable modern construction materials. Applications described include joint sealing and crack sealing, bonding and patching, repaving and coating of concrete slabs.

71 EPOXY RESIN ADHESIVES

Thiokol Chemical Corp.—This 14-page technical bulletin includes a general discussion of Epoxy Resin Adhesives; a summary of results; methods of testing; application costs of Liquid Polymer/Epoxy Concrete Adhesives; and application and working properties. Charts of curves showing time/temperature curing characteristics of LP/Epoxy Concrete System are also included.

72 EXPANSION PLATES & BUSHINGS

Lubrite Div., Merriman Bros., Inc.—Manual No. 55 contains complete information, technical data, and specifications about Lubrite self-lubricating expansion plates and bushings for bridges, buildings, refinery equipment, chemical processing equipment high temperature, missile and atomic applications. Lubrite plates or bushings are completely self-lubricating and do not require periodic maintenance or servicing. Ideal where ordinary lubrication is objectionable, neglected, expensive to maintain or for inaccessible plates or bushings.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

RELOCATED TOWNS START RIGHT WITH D-O EQUIPPED SEWAGE PLANTS

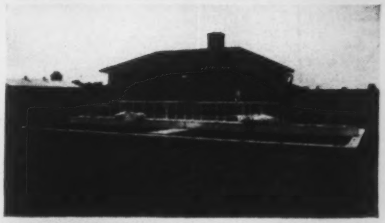
Modern installations are provided for three communities moved by St. Lawrence Seaway project

Relocation of three Ontario communities, due to construction of dams for the St. Lawrence Seaway, made modern sewage treatment plants necessary. In each case, basic equipment was manufactured and supplied by our Canadian Associate, Dorr-Oliver-Long Ltd.

D-O is a foremost supplier of sewage and water treatment equipment to meet the needs of any type of plant. For details on the wide range of units available, write to Dorr-Oliver Inc., Stamford, Conn.

IROQUOIS, ONT.
Clarifier, 30′ dia. x 12′ SWD; Digester, 25′ dia. x 18′ SWD; Sludge Pump. Design population: 5,000. Design flow to plant: 600,000 GPD.

Consultants:
Proctor & Redfern,
Toronto, Ontario.



MORRISBURG, ONT.
2 Clarifiers, primary type, 20′ square x 7′ SWD. Design population: 5,000. Design flow: average 600,000 GPD, Maximum 900,000 GPD.

Consultants:
James F. MacLaren & Associates,
Toronto, Ontario.

LONG SAULT, ONT.
2 Clarifiers, primary and secondary, each 28′ dia. x 8′ 6″ SWD. Design population: 3,000. Design flow: average 360,000 GPD, maximum 605,000 GPD.

Consultants:
Marshall, Macklin & Monaghan,
Don Mills, Ontario

DORR-OLIVER
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

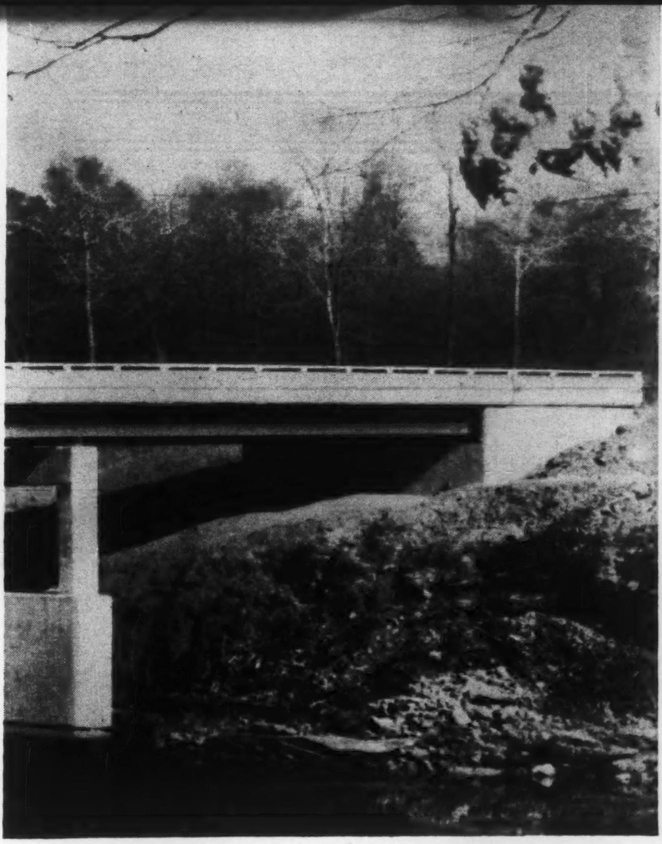
Steel bridge on Ohio Turnpike over Rocky River—designed by Tippetts-Abbett-McCarthy-Stratton.

Fast erection puts steel in the designs

by Tippetts-Abbett-McCarthy-Stratton,

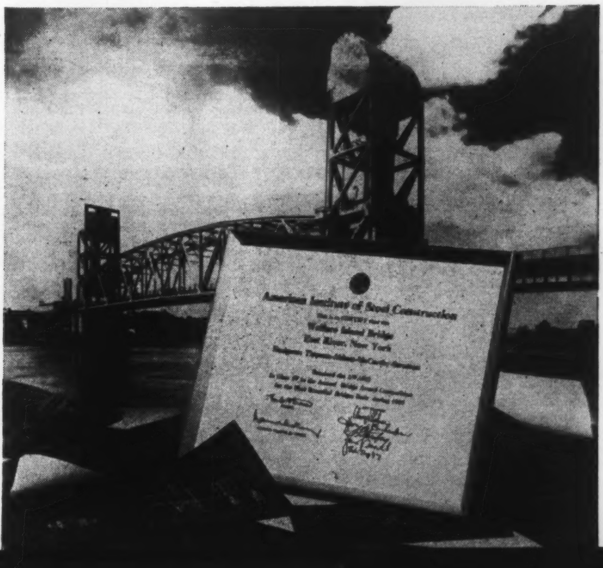
Short-span bridge on New York Thruway, designed in steel for quick erection.

Beautiful Bridge Award for 1955 won by Tippetts-Abbett-McCarthy-Stratton ▶
for the Welfare Island Bridge over the East River in New York City
—one of two awards they won for steel bridges.



# of short-span bridges

Consulting Engineers



Among a great variety of projects in Civil and Structural Engineering, many short-span steel bridges are designed each year by the firm of Tippetts-Abbett-McCarthy-Stratton, Consulting Engineers, New York City. This organization is one of the most active and widespread consulting engineering firms in the world.

They are presently involved in a number of Federal and State Highway Projects. The topographical conditions and rapidity of erection often make it more practical to use steel.

Steel saves time. Steel is a proven material for bridges. Work crews know how to handle it. Rapid construction is a factor in early completion of highway projects.

Steel spans are attractive. This is shown by the fact that two A.I.S.C. Awards for beautiful bridges were won on steel structures designed by Tippetts-Abbett-McCarthy-Stratton.

Steel is readily available. Because of the many advantages of steel bridge construction, U. S. Steel has greatly expanded its facilities to manufacture structural shapes and plates. And new, tougher high strength and alloy steels provide greater strength with less bulk. You can confidently design in steel—the material you know best, the material that offers most—knowing it will be available.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

USS

KERN
GETS YOU OUT
(of traffic and crowded areas)
IN A *HURRY*

TURN TO
KERN INSTRUMENTS
for increased working speed, simplicity and economy of operation, higher degree of accuracy.

45 SEC. SET-UP TIME with
KERN
GKI LEVEL
and KERN (Ball & Socket) TRIPOD

- Unique new design—no leveling screws.
- Compact, functional, highly portable.
- Fast, effortless operation.
- Fine tilt screw; coincidence spirit level.
- Mean accuracy as high as 13/1000 ft. per mile.

$251.80 GKI LEVEL
Including Fixed Leg Tripod

★

REVOLUTIONARY
NEW TRIPOD
Levels instrument with remarkable speed. Assures exceptional stability with ball-and-socket head supporting instrument coupling.

★

Write for Brochure GK 479-2
PROMPT, RELIABLE SERVICE
FACTORY TRAINED PERSONNEL

Kern SWISS
The FINEST in SURVEYING EQUIPMENT
KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

CATALOG DIGESTS

73 EXTRUDED CEMENT MORTAR COATING

Pipe Linings—A coating process for pipe, in diameters from 4 inches through 12 inches has been developed, which is not only superior to existing methods such as guniting or brush coating, but is also lower in cost. The cement mortar is extruded in a manner which provides a smooth, dense, uniform coating; and the bond has proven to be excellent. The process eliminates any waste of materials and increases the speed of production with consequent lowering of costs. Also available is information on a troweling device to provide a smoother-than-ever cement mortar lining with consequent improved flow characteristics in 12-in. dia pipe and larger. The company will soon have a Spunline troweling device for pipe down to 8 in. in diameter.

74 FABRICATED PIPE & PILING STEEL

Posey Iron Works, Inc.—This 15-page catalog contains in-ship and field installation photographs, which are typical of the wide variety of jobs fabricated by the company. A few of the illustrations included are: car of pipe leaving plant, driving 30-in. OD Piles for bridge piers, special steel fabrication for oil refinery, and special fitting of stainless steel.

75 FABRICATED STEEL PRODUCTS

United Steel Fabricators, Inc.—Complete details, specifications and engineering data are available on highway guard rails, bridge flooring, corrugated metal pipe, metal buildings, and leave-in-place steel forms for concrete bridge decks.

76 FACTORY-BUILT SEWAGE LIFT STATION

Smith & Loveless, Inc.—This 100-page engineering data manual on factory-built sewage pumping stations and pneumatic ejector lift stations contains bulletins, selection charts, diagrams, installation data and specifications. Over 1,000 sewage lift stations are in service across the nation, Alaska and Canada.

77 FIBRE FORMS

Sonoco Products Co.—Uses of Sonotube, fibre forms, are illustrated in a brochure. These fibre forms provide an economical method of forming round, obround, half-round and quarter-round columns. Also encasement of steel and wooden piles, existing columns and utility risers. Available in several different types, the newest which provides a form surface requiring little or no rubbing of the finished column. Technical data also available.

78 FIBRE TUBES

Sonoco Products Co.—Sonovoid, fibre tubes, were specifically developed to form voids in bridge decks; wall, floor, roof and lift slabs and in concrete piles. Uses illustrated in a brochure. Sonovoid, fibre tubes, are used in precast or cast-in-place units of conventional or pretensioned construction. Tie down and spacer method shown along with design data for 8-in. and 12-in. slabs. Other technical data available.

79 FIELD EQUIPMENT

Warren-Knight Co.—The Warren-Knight Catalogue, Part I, of Engineering Field Equipment (24 pages) has been revised and reprinted and is now available. This book includes photographs and descriptions of standard field equipment and supplies including Builder's Instruments, Compasses, Measuring Tapes, and practically everything needed for the Engineer and Builder for Field use. Paragraphs pertaining to instrument care and repair are included. Part II with a complete description of drafting equipment and supplies (48 pages) including everything needed for the drafting room is also available for free distribution.

80 FILTER MEDIA

Anthracite Equipment Corp.—A bulletin on "Anthrafilt" tells the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Information about a free technical advisory service is included.

81 FILTERS

The Eimco Corp.—Success of "Rotobelt" (Eimco Continuous Belt Drum Filters) in filtering very difficult slurries such as corn grits, chemicals, beet sugar, sewage sludge and other wastes is described in a colorful 12-page booklet, Bulletin F-2053. A series of photographs show how easy it is to change the "Rotobelt" filter medium and color drawings explain how the filter works, how it prevents blinding, is able to get thin cake discharge and a description of the automatic aligning mechanism. Filters are also discussed in Bulletins F-2049 and F-2051.

82 FLOOR ARMOR

Irving Subway Grating Co., Inc.—A 24-page color catalog on Gridsteel floor armor. Gridsteel is made of steel bars on edge, bent and joined together in a continuous hexagonal mesh pattern. Floors armored with Gridsteel last indefinitely. Gridsteel prevents ruts or potholes from forming, gives an even, tractional floor surface at all times. Catalog illustrates uses, advantages, and shows how quickly and simply Gridsteel is installed.

83 FLOOR TREATMENTS

Sun Chemical Corp.—A 4-page circular is available on floor treatments for the hardening, resurfacing, patching, and coating of new and old concrete or wood floors.

84 FOAMGLAS APPLICATION SPECIFICATIONS

Pittsburgh Corning Corporation—Six bulletins are offered. They are: Dual Temperature Equipment and Piping; Underground Piping; Insulation on Spheres; Low Temperature Equipment and Piping; Medium Temperature Equipment and Piping; and High Temperature Equipment and Piping. Each booklet contains diagrams.

85 FOUNDATION CAISSONS & PILES

Franki Foundation Co.—An interesting, informative and well illustrated brochure describes in detail the Franki method of installing Displacement Caissons and Pressure Injected Footings. Caisson load test results on representative projects and reinforced concrete cap design data are noted. Various types of pile foundations installed by Franki are indicated.

86 GEAR DRIVE

Johnson Gear & Mfg. Co.—Right angle gear drives for vertical shaft pumps and industrial use such as sewage disposal, water supply, fire and flood control, cooling tower installations, and barge service, are described and illustrated in catalog #29 and #30. Complete engineering details are also given.

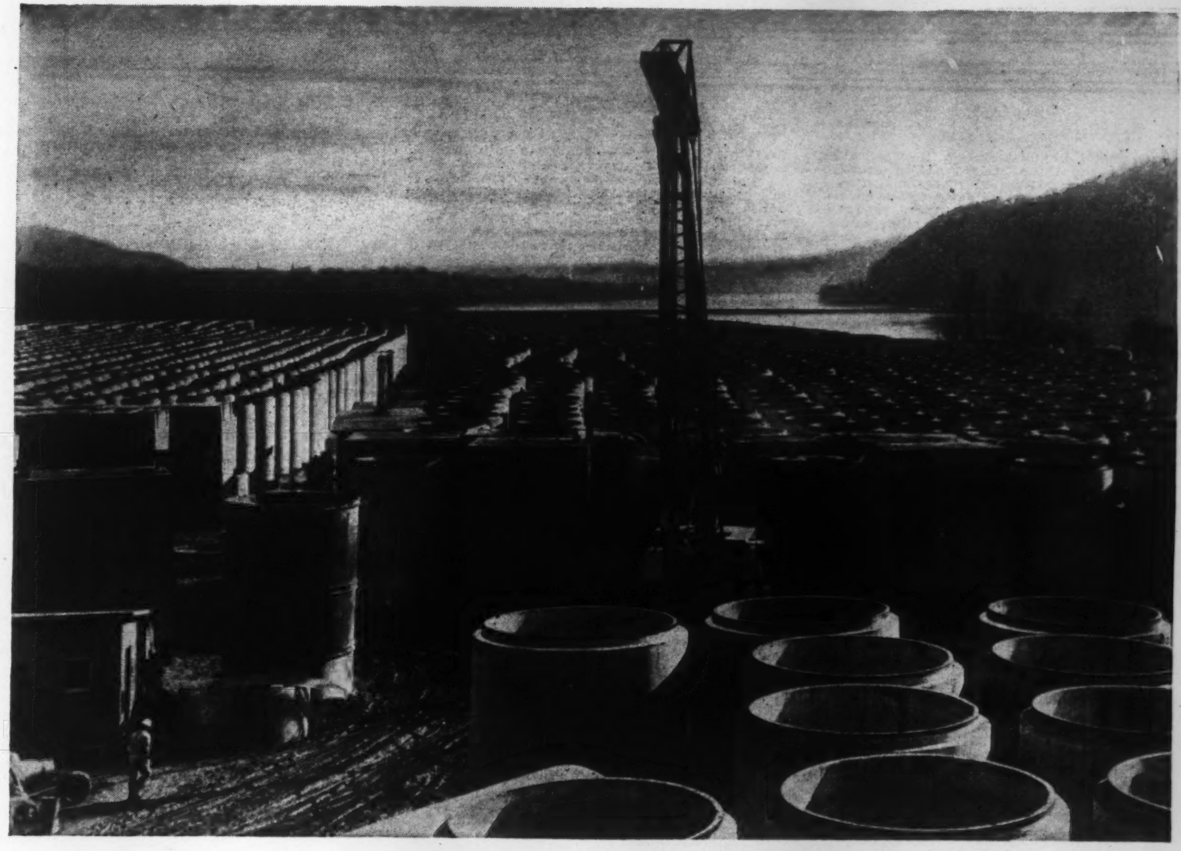
87 GEARS

The Earle Gear and Machinery Company—A twenty-page catalog describes in general, the kinds and sizes of gears manufactured by this company. Its contents deal with spur gears, bevel gears, helical gears, worm gears, racks, non-metallic gears, sheaves, sprockets, special machinery of which gears form a part, and special gear information. Illustrated with photographs, it also shows actual Earle installations.

88 GRATING FLOORING AND TREADS

Irving Subway Grating Co., Inc.—General Grating Catalog F400 contains illustrations, descriptions and complete engineering data on full line of grating products made in steel, aluminum and other metals. Catalog shows riveted, welded and pressure-locked types for use as flooring, treads, walkways, trench covers, and so on. Irving grating is safe, durable, self-draining, ventilating, clean, fireproof, economical.

PLEASE PRINT
NAME CLEARLY



Some of the 69 miles of 24- to 126-inch reinforced concrete pipe needed for the Pittsburgh sewer project

Pittsburgh chooses concrete pipe for sewer system designed to last 100 years!

The 70 communities of the Allegheny County Sanitary Authority have planned 100 years ahead for their new intercepting sewer system. This big project involves 69 miles of sewers—30 miles in tunnels and the rest open trench construction.

Needed strength, durability and watertightness are assured by concrete pipe. Extensive testing proved these qualities. Total infiltration into the first 31 miles completed was less than 3 gallons per minute. In many contract sections infiltration was found to be zero.

Other communities everywhere are also finding that concrete pipe can be designed precisely to solve their sewer problems. And concrete pipe are readily available. For the giant Pittsburgh project, special casting yards—including all test equipment—were set up at convenient close-in locations to speed up schedules, keep costs low.

For helpful information on modern concrete pipelines of all kinds, write for free literature. Distributed only in the United States and Canada.

For the Allegheny County Sanitary Authority: John F. Laboon, Executive Director and Chief Engineer; Lawrence M. Gentleman. Deputy Chief Engineer; Richard J. Dougherty, Construction Engineer.

FOR ALL MODERN PIPELINES
concrete

PORTLAND CEMENT ASSOCIATION
Dept. A10-13, 33 West Grand Avenue, Chicago 10, Illinois
A national organization to improve and extend the uses of concrete

CATALOG DIGESTS

89 GRATINGS

Borden Metal Products Co.—A 16-page catalog shows the three basic types of grating construction; more than 30 dimensional drawings of subtypes; eight safeload tables covering steel and aluminum gratings, roadway grating and sidewalk slabs plus other tables on panel widths, tread widths, floor armor, etc. Also shown are the various safety treads and their nosings. Included are the steps for careful planning and checking of the job.

90 GRAVITY SEWER PIPE

Keasbey & Mattison Co.—Asbestos-cement gravity sewer pipe, designed for economical, long life non-pressure sewer systems, is described in a 4-page folder, AP-22. Profusely illustrated, it points up savings in design, installation and operation with asbestos-cement pipe. Complete dimensions, tolerances as well as other specifications needed by the engineer are included.

91 GREATER NEW ORLEANS BRIDGE

Bethlehem Steel Co.—A 20-page booklet, with many attractive photographs, describes construction of the nation's longest cantilever bridge, from preliminary engineering to steel erection.

92 GROUTING AND SOIL STABILIZATION

Intrusion-Prepakt Inc.—Comprehensive 20-page illustrated Report #103 is the latest in a series of the company's special reports on vital construction services. It explains nineteen distinctly different applications of I-P grouting techniques; both cement and chemical. Included is a paper on stabilizing a compressor foundation, a reprint of a published article on how to correct the problem of a settling storage tank.

93 GUNITE

Pressure Concrete Co.—Gunite in all phases is described and illustrated in a 48-page booklet which contains complete specifications. Illustrations show Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on prestressed tank construction and other data. A leaflet illustrates pressure grouting to dams.

94 GUNITE REPAIRS

Indiana Gunite & Construction Co., Inc.—Literature is available on "Gunite" repairs to reservoir dams, sewers, tanks, and all concrete and masonry disintegration, new linings to coal bunkers, breechings, stacks, and swimming pools.

95 HANDBOOK OF HEAVY CONSTRUCTION

McGraw-Hill Book Co., Inc.—Free descriptive literature describes a convenient reference by Frank Stubbs Jr. It contains working information needed in all branches of heavy construction. This 1040-page book gives quick answers to questions on earthmoving, concrete, steel erection, highways and foundations.

96 HIGH STRENGTH BOLTS

Russell Burdsall & Ward Bolt and Nut Co.—Two brochures are available on high-strength bolts. Entitled "High-Strength Bolts for Structural Steel Connections" and "How to Work with High Strength Bolts", both booklets contain photographs and specifications.

97 HIGHWAY CONSTRUCTION

American Steel & Wire Div., United States Steel Corp.—Here, under one cover, is a description of the company's products for use in highways and streets. They include: Welded Wire Fabric, Multisafety Cable Highway Guard, steel and wire products for Prestressed Concrete, steel and wire products for Reinforced Concrete Pipe, American Welded Wire Fabric for tunnel and bridge construction, and for bituminous concrete road repairs.

98 HOW TO CORE DRILL

Acker Drill Co., Inc.—"Basic Procedures of Diamond and Shot Core Drilling" shows with over 80 illustrations and drawings the fundamentals of core drilling practice. Pipe driving, core recovery, core logging and storage are all covered in this pocket size book for the beginning driller. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Acker Drill Co., Inc.

99 HYDRAULIC TURBINES

The James Leffel & Co.—Details on turbines which drive both power generating and pumping units at the United States Bureau of Reclamation's Chandler Power and Pumping Plant are given in 12-page Bulletin 1098-E. Descriptive literature on other recent Leffel turbine installations will be enclosed.

100 HYDROGRAPHIC DATA BOOK

Leupold & Stevens Instruments, Inc.—This 120-page Sixth Edition Hydrographic Data Book contains hydraulic tables, conversion tables, information on using water level recorders and a treatise on the sources of errors in float operated devices. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instrument, Inc.

101 IMPROVED WATER AND SEWAGE WORKS

The Master Builders—Concrete in water and sewage works is exposed to the most severe conditions: weathering, freezing and thawing, saturation with water and chemical corrosion. Owners' reports and studies of 35 installations contained in this 20-page publication document the outstanding high performance obtained under actual operating conditions through the use of Pozzolith concrete. The discussion includes factors to be considered for proportioning of concrete for severe exposure conditions to produce low permeability and high durability.

102 INCINERATOR STOKERS

Flynn & Emrich Co.—Bulletin No. 1704 is the latest brochure that fully describes "F & E" Incinerator Stokers, giving complete detail of the equipment and its operation. The bulletin includes an incinerator history, photographs of existing installations and line drawings.

103 INDUSTRIAL THICKENERS

Walker Process Equipment Inc.—Bulletin 10-I-69 describes the Walker Process Clariflow Thickener for industrial applications. Utilizing the up-flow type clarifications principle, the unit has years of successful operation on blast furnace flue dust thickening, ore classifications, waste clarification, process liquids recovery and many others.

104 IN-PLACE REINFORCED CEMENT MORTAR LINING

Pipe Linings—Information is available on rehabilitating old pipelines in place and adding strength to them to resist internal working pressures and external loadings. The company's specialists will place steel reinforcing rod in any pipeline 24 in. in dia or larger and embed it in a cement mortar lining. The maximum diameter of the spiral reinforcing rod for pipe sizes from 24 in. to 48 in. is ¼ in. Pipe over 48 in. I.D. may be reinforced with steel rod up to ⅜ in. dia. The spacing of the reinforcing rod may be varied from ½ the dia of the rod to a 3 in. maximum depending upon the strength requirements for the equivalent steel area.

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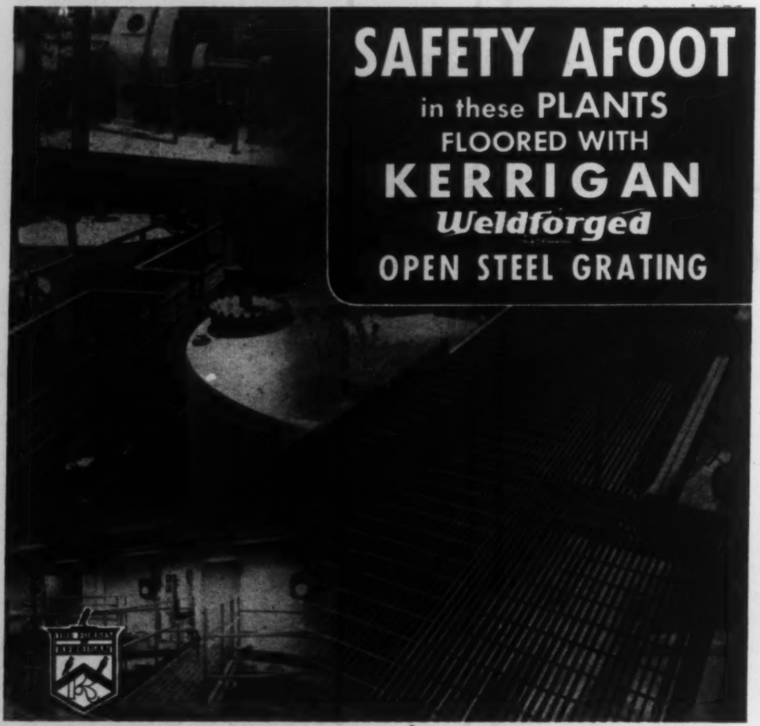

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Nashville 2, Tennessee

CATALOG DIGESTS

105 IRON & MANGANESE REMOVAL

Walker Process Equipment Inc.—Bulletin 2W-51 describes equipment for iron and manganese removal in municipal or industrial water treatment. Bulletin includes layouts, illustrations and specifications.

106 JETTING PUMPS

Griffin Wellpoint Corporation—A booklet illustrates jetting pumps for pile and caisson jetting, oil pipe line testing, water supply and fire protection. The illustrations show unusual set-ups for high-pressure jetting, including parallel and series pumping arrangements.

107 JOISTS

Haven-Busch Co.—A new 8-page catalog describing the "L" series joists including specifications, design tables and other pertinent data, is now available.

108 KON-X BEARING PADS

Keasbey & Mattison Co.—A data page is offered describing bearing pads composed of asbestos fibers in combination with a synthetic rubber elastomer. They are ideal as pads under prestressed concrete beams placed over abutments. Resiliency is maintained despite extremes in temperature. The data page details other uses as well as physical parameters.

109 LIGHTING STANDARDS

Kerrigan Iron Works, Inc.—A multi-page loose-leaf catalog containing engineering data on steel and aluminum street lighting standards, mast arms and brackets is available. They are continuous tapered and octagon shaped for greater strength. The brochure contains comparison tables on strength of octagon shape over round and fluted shapes.

110 LIGHTWEIGHT PIPE & FITTINGS

Naylor Pipe Co.—Bulletin No. 59 illustrates and describes spiralweld pipe for construction uses. Push-pull ventilation, high and low pressure air and water lines, dredging pipe, etc. in diameters from 4 to 30 in. It includes standard fittings, welded flanges, one-piece Wedgelock couplings, and connections for a pipe line requirements.

111 LIQUI-SEAL UNIT LINE PUMPS

Johnston Pump Co.—A newly published bulletin on the company's "no-leak" line of vertical pumps designed particularly for the handling of volatile fluids, is offered. It covers the principal types of applications, plus a detailed description of the exclusive no-leak fluid bypass.

112 MASONRY SAWS AND BLADES

Clippr Mfg. Co.—Circular #2023 describes the SuperMatic Hi-Speed 14 in. and Universal 20 in. to 14 in. Masonry Saws. Price list #1058 gives information on Clipper SuperMatic Hi-Speed 14 in. and Universal 22 in. to 14 in. 3 hp Masonry Saws and Clipper Diamond, Abrasive and Break-Resistant Blue Bond blades. Clipper Concrete Saw prices and specifications on models from 1½ to 36 hp Longitudinal Concrete Saw and Diamond and Green Con blades for concrete sawing.

113 MEASURING FLUMES

Thompson Pipe & Steel Co.—Four pages of tables on Free-Flow discharge for Parshall Measuring Flumes up to 20-ft throat width are included in the catalog describing this all-steel product which provides accurate measurement of water and fluids in open channels and ditches for irrigation systems, water works, sewage and industrial plants. They are also made of stainless steel and aluminum.

114 MECHANICAL DRAWING EQUIPMENT

Eberhard Faber Pencil Co.—A full color descriptive circular illustrating Microtomic Mechanical drawing pencils, woodcased drawing pencils and engineering erasers is available. Pencil numbers and trade names are Microtomic 607 lead holder and Microtomic 600 woodcased. Eraser numbers and names are 521 Race Kleen plastic eraser; 101 Pink Pearl; and 6002 Rubkleen.

115 MOBILE BATCH PLANT

The Heltzel Steel Form & Iron Co.—An illustrated 4-page brochure pictures how big plant capacity of 100-150 tons is achieved in a truly mobile plant. This highway paving plant is truck driver, push-button operated and capable of two complete batches every 13 sec with automatic equipment. The plan is assembled and ready for operation in a very few hours and disassembles in two hours. Self-contained wheels and towing tongues on batcher and bin sections permit towing by single axle dump trucks.

116 MOTOR GRADER

Galion Iron Works & Mfg. Co.—An informative 4-page bulletin on the Model 160 Motor Grader has been issued. The heavy-duty, constant-mesh, six-speed transmission of this big 160-hp grader, as well as other operating and construction features, are fully described and illustrated. Complete specifications are included.

WALKER PROCESS PACKAGE PLANTS

UNIT DESIGNS FOR SMALL SEWAGE TREATMENT PLANTS
SIMPLE OPERATION — 90% automatic
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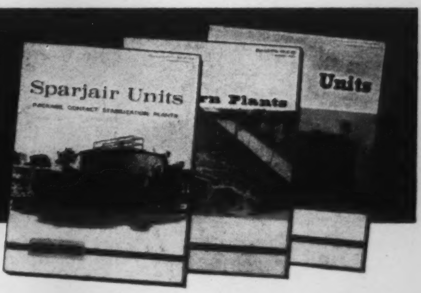
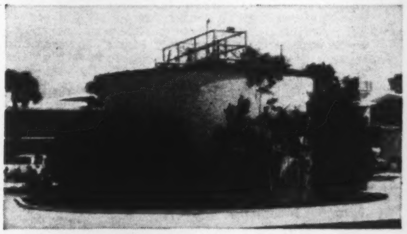


Details and preliminary plans are available to Consulting Engineers and their Architects, concerned with the design of small communities, subdivisions, institutions, schools, etc.



SPARJAIR Unit installed at a large Florida motel to handle 25,000 gpd combined sanitary and restaurant wastes. Note proximity of plant to motor court. Odor-free operation eliminates need of isolating plant.

SPARJAIR UNIT — Nested Contact Stabilization Plant — an easy to operate, low cost, small sewage treatment plant that is a model of simplicity. Designed on a new but proven principle, the contact stabilization process aerates and thoroughly oxidizes all odors in the sewage and overcomes previous objections to locating a plant near residences, shopping areas, schools, etc. Raw sewage settling tanks and septic digesters are eliminated. This plant utilizes a separate chamber for complete aerobic digestion (42% volatile remaining) of excess sludge.

Simple operation with minimum moving parts requires only part time attention. Capacities from 50 to 5000 population equivalent.

AEROBURN PLANTS — Package Aerobic Digestion; 24-hr. "Wet Burn" Aeration—designed for installations where economy is a prime factor and clarity of plant effluent is not vital. As with SPARJAIR units, the operation is odor free and practically automatic; with no delicate biological balances to achieve and hold.

Four standard sizes at 50, 100, 150 and 200 population equivalent.

SPARJPAC — Package Trickling Filter Plants — combines trickling filter and "wet burning" digestion in a two-story, compact design to provide best features of each type of treatment. SPARJPAC plants utilize DOWPAC® trickling filter media, developed by The Dow Chemical Company.

Design capacities range from 50 to 2500 population equivalent.

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CATALOG DIGESTS

117 MOTOR SCRAPER

Allis-Chalmers Mfg. Co.—Catalog MS-1312 describes the engineering features and operating advantages of the TS-260 motor scraper, powered by the 230 hp 16000 Diesel engine. Pictures are included of the scraper, its power plant and power train. The 16-page catalog also includes information on the 20-ton rear dump wagon, the TR-260, and specifications of the wagon and motor scraper.

118 MYLAR POLYESTER FILM

E. I. Du Pont de Nemours & Co.—The unusual combination of properties offered by "Mylar" polyester film is detailed in Booklet A-8019. The physical, electrical, chemical, and thermal characteristics of this toughest of all plastic films are tabulated. Typical applications in the drafting, stationery, electrical, recording tape, metallic yarn, surfacing, packaging and other fields are described.

119 NEW SEWAGE PUMP STATION BULLETIN

Smith & Loveless, Inc.—This eight-page color bulletin describes the operation, features of design and advantages of factory-built sewage pumping stations. The "Non-Clog" sewage pump is featured and manufacturing details are emphasized. Supplied with complete engineering data manual on lift stations.

120 NON-BONDING TENDONS

The Prescon System—This folder provides a description of the company's non-bonding tendon, the use of which eliminates the grouting operation. Included also is a description of the tendon and coating materials, as well as advantages attributed to its use, pictures of the tendon, the wrapping operation and certain applications.

121 OILLESS SELF-LUBRICATING BEARINGS

Spadone-Alfa Corp.—This literature describes Metaline Oilless Self Lubricating Bronze Bushings and Wear Plates for Industrial and Mechanical applications. Exclusive pre-molded lubricant assures dependable service under heavy load, high temperature, submerged and corrosive conditions. They are custom made in a wide variety of bronze alloys to meet the specific duty and application.

122 OPEN FLOORING

Blaw-Knox Co.—Safety, visibility, permanence, and easy maintenance are just a few advantages of open flooring for industrial and public works applications that are described in this 24-page booklet. The literature illustrates the use of open flooring—or electroforged grating—in many industries, including steel, power, railroad, paper, chemical, truck and automobile, food petroleum, aircraft, coal, and shipbuilding. In addition, the catalog features grating applications in sidewalks, locks and dams, and sewage treatment plants.

123 OPEN STEEL BRIDGE FLOORING

Kerrigan Iron Works, Inc.—A catalog on Greulich 4-way Grid, 5-in. depth. It contains illustrations, full engineering data including properties and load tables. The pamphlet explains the ease of filling half depth with concrete where needed, economical, speedy field erection, and why 20% fewer field welds are needed. Grid fabricated in panels 7-ft 3-in. wide with lengths up to 42-ft.

124 OPEN WEB STEEL JOISTS

Laclede Steel Co.—The catalog and load table for both "S" and "L" Series open web steel joists manufactured in accordance with the Steel Joist Institute standards and specifications are now available. In addition to a description of the joists, complete SJI specifications are included as well as load tables in 6-in. increments for all "S" Series joists up to 48-ft 0-in. span and "L" Series joinsts up to 96-ft 0-in. span. Complete description and cuts of available accessories as well as recommendations for special conditions such as cantilevers and varied types of bearing members are included.

125 OPEN WEB STRUCTURAL MEMBERS

Macomber Inc.—This 28-page booklet features Allspans, the economical high-strength open web floor and roof framing members which cover the entire range of sizes through 120 ft. They utilize high-strength, cold roll-formed V-Section chords to provide maximum lateral rigidity and reserve strength. Allspan chords are designed in accordance with the Light Gage Steel Design Specifications of the American Iron & Steel Institute, using a guaranteed minimum yield stress of 47,000 psi; web members are designed within A.I.S.C. allowable stresses.

126 OPTICAL PLUMMET

Warren-Knight Co.—The Warren-Knight Optical Plummet, known as the Tele-Plumb, is exclusive in that it is fastened to the end of the Transit or Transit-Level telescope and the sight to the tack beneath the instrument is made with the full power of the main telescope. The Tele-Plumb pamphlet gives complete information on this optical plummet which saves time in setting up accurately and without the use of a Plumb Bob. The Tele-Plumb is attached permanently and the instrument can be used for regular service without removing the Tele-Plumb.

127 "OXIGEST" SEWAGE TREATMENT PLANT

Smith & Loveless, Inc.—This engineering data manual on the "Oxigest" sewage treatment plant contains notes on design, engineering data, specifications and installation instructions, plus lists of accessory equipment. Now available in 27 standard sizes, these factory-built units are ideal for small sub-divisions, schools, motels and factories in need of dependable sewage treatment with minimum maintenance and low installation cost.

128 PATENTED CLEANING PROGRAM

National Power Rodding Corp.—A new 2-color brochure completely describes exclusive patented equipment used to restore water pipes to a guaranteed 95% of normal capacity, at a fraction of the cost of new pipe installations.

129 PAVING HANDBOOK

American Bitumuls & Asphalt Co.—The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials. These include road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, with condensed Asphalt Institute specifications. Also, there is data on Laykold compounded asphalts for flooring, tennis courts, and protective coatings.

130 PIER REPAIR

Masonry Resurfacing & Construction Co., Inc.—"Iron Girdle Holds Concrete for Bridge Pier Repair" is a reprint illustrating the methods and technique of "in the dry" repair of a 24-ft dia pier near Baltimore, Md. These procedures which revitalize deteriorated structures and add many years of useful life to an old structure are similar to those utilized in the "Dri-Por" system of pile repair. Many illustrations clearly show the work in various stages of repair.

131 PILE DRIVING

C. L. Guild Construction Co., Inc.—An 8-page brochure, with action photographs and pictures of recently completed structures resting on Cobi Piles is available. It includes a detailed brief on piles and pile driving, with special attention to methods and specifications for installation of Cobi Cast-in-Place Concrete Piles.

132 PILE REPAIR

Masonry Resurfacing & Construction Co., Inc.—An 8-page illustrated booklet is offered describing the "Dri-Por" system of pile repair and encasement applied to bridges and piers. The booklet describes several interesting applications of the "Dri-Por" system and relative costs. Also included is a description of the "Dri-Por" K-Box which allows repair of concrete piling "in the dry."

CATALOG DIGESTS

133 PILES

Raymond International Inc.—Standard and step-tapered piles are described in Catalog S-59 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation. Domestic operations include harbor and waterfront construction, and cement-mortar lining of pipelines in place. Raymond's services abroad also include all types of general construction.

134 PILES

The Union Metal Mfg. Co.—Catalog No. 91 on Monotube foundation piles has been announced. In addition to general descriptive information, the catalog contains engineering data covering physical properties, specification suggestions and test loading; also, contractor data on concrete volumes and weights is included. Advantages listed are: light weight, easy handling, economical field extendability, visual inspection after driving, and highload carrying capacity with extra high economy per ton load supported.

135 PIPE CLEANING EQUIPMENT

Ace Pipe Cleaning, Inc.—A new bulletin describes modern mobile pipe cleaning equipment ready on a moments notice to solve any water main cleaning project. Trained crews operating specially designed power-driven tools clean mains with maximum efficiency and speed.

136 PNEUMATIC EJECTOR LIFT STATIONS

Smith & Loveless, Inc.—A new bulletin on factory-built "Mon-O-Ject" pneumatic ejector sewage lift station contains features of design, new operational characteristics and advantages of this low-cost ejector lift station. Available in complete engineering data manual on sewage lift station with specifications and design notes.

137 PEUMATIC-TIRE ROLLER

The Galion Iron Works & Mfg. Co.—Bulletin No. 434 gives complete information and specifications on the Galion 12-ton, 9-wheel pneumatic-tire roller. Illustrations clearly explain the exclusive Equamatic front end construction of the roller. This construction is claimed to provide, through the automatic equalizing action of triple king pins, utmost operating stability and balance for the roller when working over uneven and sloping ground.

138 POCKET PENETROMETER

Soiltest, Inc.—A bulletin illustrating and describing a new Pocket Penetrometer for cohesive soils, the Kelly Ball rapid tests of fresh concrete, a small Vibrating Sieve Shaker for field or laboratory and a Concrete Air Indicator is now available.

PLEASE PRINT NAME CLEARLY

139 POCKET TRANSIT

William Ainsworth & Sons, Inc.—Information is available on the Brunton Pocket Transit, which is widely used for reconnaissance and preliminary surveying on the surface and underground, for taking topography, and for geological field work. In addition to taking horizontal and vertical angles, it may be used as a prismatic compass, level, clinometer, plumb or alidade. Essentially the transit is a magnetic needle set in an accurately graduated circle in a case which opens into a versatile sighting arrangement. A level is attached to a vernier for reading vertical angles.

140 POINT TO POINT TELECOMMUNICATIONS

Marconi's Wireless Telegraph Co. Ltd.—Published three times yearly, "Point to Point Telecommunications" is designed to interpret trends and techniques in telecommunications for the benefit of the user and for the practical systems planning engineer. It deals with the more practical aspects of communications and in particular point-to-point fixed services.

141 PORTABLE ASPHALT HEATER

Industrial Boiler Co.—Literature is available on a completely automatic, portable materials heater, which can furnish hot oil and heat asphalt to the desired temperature within one hour from starting. The trailer-mounted, self-contained "Chattanooga M. Heater" offers 15,000 gal of Asphalt Storage, 9,500 gal Fuel Storage, plus very low fuel consumption.

142 PORTABLE STABILIZER PLANTS

Hetherington & Berner, Inc.—Bulletin S-59 describes two portable Stabilizer plants designed to provide more accurate proportioning and control of base materials and to give large capacity operation with minimum costs. These plants provide capacity up to 400 cu yd per hour. Feeder, mixer and aggregate conveyor are wheel mounted, to provide extreme portability and to operate in running position without jacking up or cribbing.

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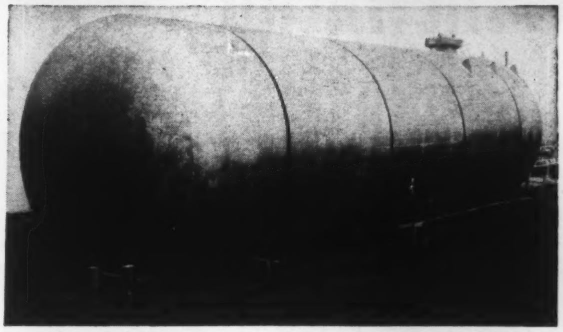

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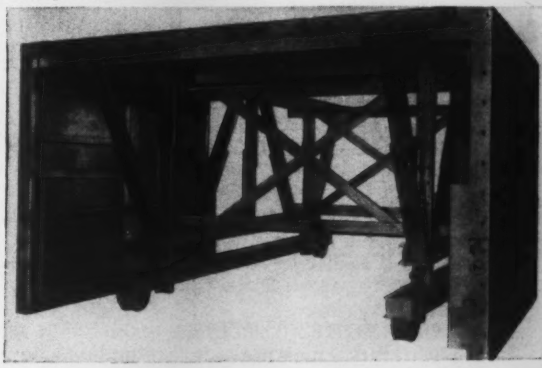

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CATALOG DIGESTS

143 POST-TENSIONING PRESTRESSED CONCRETE

The Prescon Corp.—This descriptive brochure gives complete detailed information regarding The Prescon System for post-tensioning prestressed concrete. The brochure includes a brief background history, examples of structures, descriptions of placing and stressing data and descriptions of the various size tendons.

144 PRECAST CONCRETE BRIDGE MEMBERS—AMDEK

American-Marietta Co.—An 8-page folder shows how Amdek prestressed, pretensioned concrete spans revolutionize bridge construction methods. It also illustrates skew beam tests, load distribution tests and tests to destruction being conducted in independent laboratories.

145 PRECAST STRUCTURAL CONCRETE

Freyssinet Co., Inc.—Prestressed Concrete News Vol. 2, 1959, features examples of the use of precast concrete in grandstand construction. Of prime consideration in the selection of a structural material for outdoor grandstands is durability against the elements, safety in the event of fire, and economical construction. The choice of precast concrete assures the owner that these criteria will be achieved. Each of the structural members used in the grandstand is efficiently manufactured in a precasting plant by skilled craftsmen, assuring a far superior concrete finish than can normally be obtained by job site construction, the manufacturer states.

146 PRESSURE PIPE CLEANING

Robinson Pipe Cleaning Corp.—Proof of success of pressure cleaning process is outlined in a recently compiled bulletin. Patented pressure tools scrape and cut all tuberculation and encrustration from water mains regardless of size or condition.

147 PRESSURE SENSITIVE INSTRUMENTS

Wallace & Tiernan Inc.—Catalog TA-1006-A-4 describes a full range of pressure sensitive instruments. Listed are absolute pressure indicators; gauge, vacuum and differential pressure indicators; precision mercurial manometers; and pressure control instruments. All these instruments are precision manufactured and individually calibrated. The catalog identifies each instrument, listing its ranges and principle features.

148 PRESTRESSED CONCRETE PILES

Raymond International Inc.—Catalog CP-3 decribes and illustrates Raymond cylinder piles of prestressed concrete. Information is given on the merits of prestressed concrete piles for foundations of bridges, waterfront and off shore structures. Shown are many examples of installations and suggested designs.

149 PRESTRESSED CONCRETE TANKS

The Preload Co., Inc.—"Preload Prestressed Concrete Tanks," Bulletin T-22, is a well illustrated, 4-page booklet describing the history of prestressed tanks, design requirements, construction, walls, and floors. Also available is a 4-page brochure, T-23, which is entitled "Prestressed Concrete." This bulletin tells of a 2,000,000 gal elevated water tank in Tyler, Texas.

150 PRESTRESSED CONCRETE TANKS

The Preload Co., Inc.—"The Design of Preload Tanks", Bulletin T-19 is a completely illustrated 8-page booklet describing the design calculations for a prestressed concrete tank. Complete formulas are given for floor, wall, dome and dome ring design.

151 PRESTRESSED CONCRETE TENSIONING MATERIALS

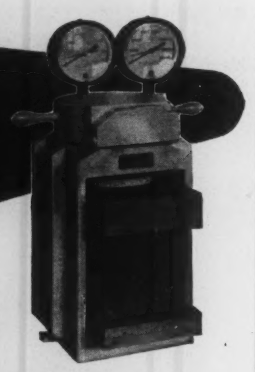
John A. Roebling's Sons Div. of The Colorado Fuel & Iron Corp.—This new 20-page booklet is a comprehensive introduction to the country's most rapidly-growing construction method. It contains photographs and drawings of various structures and pretensioned bonded prestressed concrete members and their applications. There is a full description of a prestressed casting bed and how it works and graph and technical data on tensioning strands.

152 PRICE LIST

Warren-Knight Co.—A new Price List of Warren-Knight Transits and Levels together with a replacement parts price list of accessories, etc., including prices on miscellaneous instruments, special instruments such as Precision Clinometers, Precision Quadrant Levels, Cloud Height Clinometers, Three-Arm Protractors, complete with schedule of rental rates and conditions, is now available for free distribution.

153 PROPELLER AND MIXED FLOW PUMPS

Layne & Bowler, Inc.—Entitled "Layne Propeller and Mixed Flow Pumps", Bulletin 350 gives complete and detailed information including cut away drawings, installation sketches and measurements, delivery and performance tables, plus complete information on all uses and applications of these pumps.



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- COMPACT—entirely self contained unit.
- ACCURATE—meets ASTM and AASHO specifications.
- EASY TO OPERATE—loads to 200,000 lbs. are developed easily with hand operated hydraulic pump. Motor driven pump is also available.
- LARGE TESTING AREA—for concrete blocks to 9″ x 18″ and standard 6″ and 12″ dia. concrete cylinders.
- TWO RANGE CAPACITIES—for complete testing flexibility. Loads are indicated on large, direct reading dials.
- FLEXURE TESTING—attachment available for concrete beams.

For full information, write today for Bulletin 55.

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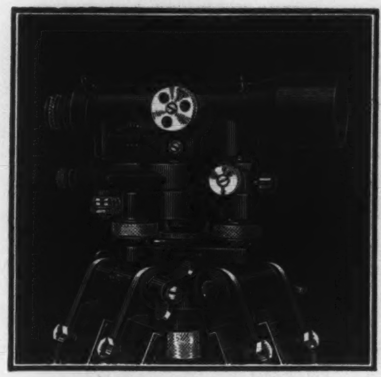

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DIETZGEN

TIDE GATES

Fig. B-68, Type M
(CIRCULAR)

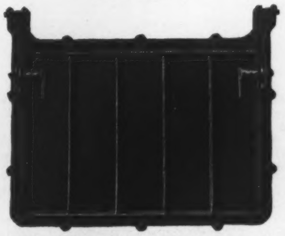


Fig. B-61, Type MM
(RECTANGULAR)

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

CATALOG DIGESTS

154 PUMPING STATIONS

Zimmer & Francescon—An 8-page color bulletin and a 33-page manual describe completely prefabricated pumping stations, pneumatic ejector stations and water booster stations, each custom built to meet the individual job requirements. Users include municipalities, sub-dividers, shopping centers, industrial developments, motels and resort areas.

155 RANNEY-COLLECTORS

Ranney Method Water Supplies—A 13-min, 16-mm color film with sound track describes the Ranney-Collectors and the testing for them. This film is available for loan to consulting engineers.

156 REINFORCED CONCRETE PIPE—HI-HED

American-Marietta Company—A pamphlet containing many photos showing how elliptical Hi-Hed Reinforced Concrete Pipe saves trench width in congested areas and has up to 50% greater strength than its round pipe equivalent. Includes charts on headwall details, physical characteristics and hydraulic properties and discharge graphs. Also folder on elliptical Inner Circles Pipe illustrating quick passage of pipe through pipe underground without disruption of surface traffic.

157 RING-JET VALVE

Allis-Chalmers Mfg. Co., Hydraulic Div.—A "Ring-Jet" valve designed for easy regulation and control of water under free discharge is described in Bulletin 02B9154. The valve, which is equipped with a hood to minimize the spray and to admit air to the jet, incorporates the simplicity of construction, radially balanced hydraulic design, and easy operation of the Howell-Bunger valve while very nearly matching its high discharge coefficient.

158 ROLLING DOORS

The Kinnear Mfg. Co.—According to this 36-page booklet, these rolling doors meet nine major requirements: "Registered" life extension; quick, easy operation; space saving; greater durability; fire protection; maximum safety; general protection; neat appearance; and economical installation. Steel rolling service doors, steel rolling fire doors, and bifold doors are a few of the rolling doors discussed in the catalog. Also included are specifications, photographs, and an index to door types.

159 ROTARY DISTRIBUTORS FOR TRICKLING FILTERS

Walker Process Equipment Inc.—Bulletin 23-S-97 describes Walker Process Rotoseal and Turntable type rotary distributors. Design criteria, layouts, details and installation illustrations are included.

160 SAND HOG EQUIPMENT

Mayo Tunnel and Mine Equipment—Colorful Bulletin No. 23 illustrates Tunnel Shields, Air Locks, Lock Doors and other Sand Hog Equipment employed in many parts of the world.

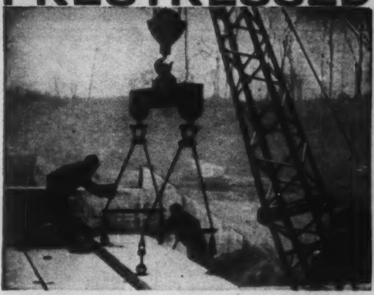
161 SCOPE IN METAL CONSTRUCTION

Pittsburgh-Des Moines Steel Co.—A 36-page General Brochure describes the capabilities and diversities of PDM Metal Construction. The facts presented serve as a useful measure of the highly developed knowledge and craftsmanship of the company in engineering, research, fabrication and construction of steel, stainless steel, stainless clad steel, alloy and aluminum.

162 SEEPAGE AND POLLUTION CONTROL

Gulf-Seal Corp.—Presents dependable Prefabricated Asphalt Lining in its Engineering Brochure (Fourth Edition). Included are installation details, specifications, and photographs of numerous installations. The tough, flexible lining is designed to solve many problems involved with the storage of industrial salt water and waste chemicals, municipal treated and untreated water, and relining steel and concrete reservoir surfaces.

PRESTRESSED



Placing of Amdek hollow box girders by means of *Richmond* Lifting Inserts with loads spread and equalized.

Lifting Inserts for Beams & Girders

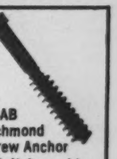
Increased use of Prestressed Beams and Girders has led to the development of special inserts for lifting these units from casting beds, and placing them in their final position on the job.

Richmond Screw Anchors can be used where the mass of concrete provides sufficient distribution in width and depth to develop the strength.

Tyloops are used where the width and depth are sufficient for proper anchorage, where the unit has to clear reinforcing steel or other obstructions. Tyloops can be made in special shapes.

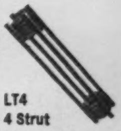
Extended Coil Lifting Tyscrus and 4 Strut Lifting Tyscrus are especially designed for thin walled Hollow Girders where the load distribution must be placed in the compression area of the prestressed girder.

All of these Lifting Inserts have actual ultimate strengths of at least twice their working loads in concrete at required lifting strength.

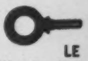


SCAB
Richmond
Screw Anchor
& Bolt Assembly.

LT2E
Lifting
Tyscru
with
Extended Coil



LT4
4 Strut
Lifting Tyscru



LE
Lifting Eye Bolt

TL4F
4 Strut
Tyloop
Flared

For more information about these and other Richmond Lifting Inserts send for the Richmond Data Book on Lifting Inserts. And if you have any specific concreting problems ask us about them.

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AND BE SURE
IT'S RICHMOND
Richmond
SCREW ANCHOR CO., INC.
816-838 LIBERTY AVE., BROOKLYN 8, N.Y.
315 SOUTH FOURTH ST., ST. JOSEPH, MO.

CATALOG DIGESTS

163 SELF-LUBRICATING BEARINGS

Lubrite Div., Merriman Bros., Inc.—Manual No. 56 is a 24 page book filled with complete information, technical data, and specifications about Lubrite self-lubricating bushings, bearings, and washers for industrial equipment, machinery, Hydro-electric, high temperature, missile and atomic applications. Lubrite bearings are completely self-lubricating and do not require periodic maintenance or servicing. Ideal where ordinary lubrication is objectionable, neglected, expensive to maintain or for inaccessible bearings.

164 SELF-LUBRICATING EXPANSION PLATES

Spadone-Alfa Corp.—Literature providing complete information covering Metaline oilless self-lubricating expansion plates and bridge bushings; also, Metaline bearings for underwater installations as found in dam and hydroelectric projects. Metaline products fully meet all federal and state requirements covering this type of material. This exclusive lubricant assures long, dependable service in heavy load, high temperature, submerged and corrosive applications.

165 SEWAGE REGULATORS

Brown & Brown, Inc.—manufacture a line of float controlled quadrant gates, in 37 sizes, to automatically control the diversion of sanitary flows from combined sewers to interceptors. Such automatic gates may be actuated either from head or tailwaters or dually from two sources. Bulletin 81A contains capacity and dimension charts.

166 SINGLE-ACTING PILE HAMMERS

Vulcan Iron Works Inc.—The company has added to their line of Single-Acting Pile Hammers five new sizes designated as; 06, 08, 010, 014, and 020. Pertinent specifications covering these new sizes are now contained in a recently issued descriptive bulletin.

167 SLUICE GATES

Rodney Hunt Machine Co.—The first basic improvement in sluice gates in many years, the patented HY-Q flush bottom closure sluice gate, is described in Catalog 75. This booklet, with 12 pages of illustrations, clearly shows all details of construction, installation, and operation of the unique gate as used in water filtration plants, power plants, municipal and industrial plants, dry-docks, and flood control.

168 SLURRY SEAL

American Bitumuls & Asphalt Co.—"Bitumuls Slurry Seal" is an operation which consists of mixing the aggregates with Bitumuls and water to a slurry consistency in a transit mixer, and spreading over the pavement by a specially constructed squeegee type spreaderbox. The action of the squeegee forces the slurry into the fine cracks of a weathered but still sound surface of an old asphalt pavement, thereby reducing expensive maintenance patch construction to a minimum.

169 SOIL COMPACTION

Vibroflotation Foundation Co.—Available is a booklet entitled "Soil Compaction by Vibroflotation" which describes the soil consolidation and engineering services of the Vibroflotation Foundation Co. The booklet illustrates the compaction of 8 to 10-ft cylinders of sandy soil to provide a firm foundation of sand for any type of structure. To make sure of complete coverage in a given area, these cylinders are overlapped according to a predetermined pattern under individual loadings or under entire building areas.

170 SOIL TESTING DEVICE

Charles R. Watts Co.—Full information on the Dens-O-Meter is available. Developed by soils engineers of the Department of Highways, State of Washington, this device is now in use throughout the world for making field density and moisture tests in wide range of soils—fine, coarse, granular base and gravels. It is accurate and fast in small or large holes up to ½ cu ft—3 ft deep.

171 SOLVING TUNNEL CONCRETING PROBLEMS

The Master Builders Co.—How excavating and concreting problems encountered on 12 major tunneling projects were solved is the subject of this 28-page publication. Among the projects included in the study are: the Hydro-Quebec Bersimis job and its unique concrete requirements; The Aluminum Co. of Canada's Kemano project with its huge underground powerhouse; and the extreme water and heat conditions encountered at Tecolote, California. These and nine other case histories tell how Pozzolith was used to help solve these concreting problems.

172 SPEED REDUCERS

The Earle Gear and Machinery Company—A sixteen-page illustrated catalog, describing speed reducers as applied to operating machinery, particularly bridge machinery, is available. Outlined are specifications, service factors, horsepower ratings and dimensions of the particular units illustrated. Gasoline power units are also dealt with in a compact, easy-to-read form. Photographs are shown of actual installations with miniature blueprints included.

173 SR CLARIFIER

Dorr-Oliver Inc.—This 4-page, two-color bulletin entitled, "The Dorr SR Clarifier," describes the design features and advantages of the new final unit for continuous, rapid sludge removal. Bulletin No. 6193 also includes installation photographs and line drawings of the unit, and a chart of design data.

174 STEEL GRANDSTANDS

Pittsburgh-Des Moines Steel Company—A 4-page illustrated folder thoroughly describes construction, design factors, seat spacing, aisle width, specification check points and over-all advantages of these permanent stands for outdoor seating. Formulas for calculating seating capacities are provided, and capacity tables. Types of stands pictured include school, racetrack, baseball and fairground structures. Unit construction and adaptability are features of PDM Steel Grandstands.

175 STEEL JOISTS

American Bridge Division—This 40-page steel joist catalog contains complete design information for spans up to 120-ft. Such subjects as design calculations, bridging, properties and dimensions, end details and accessories, load tables, marking systems for ordering, and specifications are clearly and completely covered in this catalog.

176 STEEL TROWEL FINISHING

Alpha Portland Cement Co.—A pamphlet is available on Steel Trowel Finishing. How to get the best results from each finishing operation is shown through pictures and captions. How to avoid dusting and crazing is also discussed. A folder entitled "Cracks in Concrete" is also available.

177 STRATAGRAPH

Edo Corp.—An illustrated brochure describes the Model 400 Stratagraph, strata penetrating sonar which records, with sharp definition and complete accuracy, formations underlying rivers, lakes and other relatively shallow bodies of water. Sediment, intermediate layers, bed rock and faults are readily distinguished and pictorially shown on permanent chart. The brochure illustrates equipment and typical recordings.

F/S TILTING LEVELS

Models
5167-5168-5169

- Erect images—25x or 30x magnification
- Coincidence level viewed in telescope field
- Leveling accuracy .01 ft. per mile or better
- Servicing by factory specialists
- 18 months guarantee

F/S offers a complete line of high quality engineering instruments. Ask your nearest dealer or write today for detailed literature.

FILOTECNICA SALMOIRAGHI, INC.
254 5th Ave., New York 1, N. Y.
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F/S DISTRIBUTORS: The A. Lietz Co., San Francisco and Los Angeles, Calif.—National Blue Print Co., Chicago, Ill.—Watts Instruments, Columbus, Ohio—Geo. F. Muth Co., Inc., Wash., D. C.—CANADA: Instruments 1951 Ltd., Ottawa, Toronto, Regina, Montreal.

CATALOG DIGESTS

178 STRESS-RELIEVED STRAND

Bethlehem Steel Co.—This 4-page brochure, F 667, gives a basic description and use-characteristics of this high-tensile-strength steel strand for use in pre-stressed concrete construction.

179 STRUCTURAL BEARING BOLTS

Automatic Nut Co., Inc.—Engineering data and descriptive literature are available to architects, engineers, contractors, and fabricators on High Tensile Structural Bearing Bolts with Interrupted Ribs used in conjunction with Anco lock nuts; no torquing is required. Also available is literature on Anco self-locking hex nuts.

180 SUBMERSIBLE PUMPS

Layne & Bowler, Inc.—A new informative bulletin entitled "Submersible Pumps" (No. 202) has been released. Detailed cross section drawings plus colored illustrations of the many and varied uses and applications of the Submersible Pumps make up the bulletin. Applications covered include: plant water systems, irrigation, reservoir pumping and municipal primary water supply.

181 SUPPLYING WATER

Ranney Method Water Supplies Inc.—This brochure gives the history of horizontal wells and infiltration galleries, describes the principles and applications of Ranney-Collectors and the testing procedure required for their installation and also tells of the biochemical problems involved in underground water and the methods of handling them. Also available is a booklet on Construction Services, which describes specialty construction services involving deep sub-aqueous foundations and structures.

182 SURFACE TREATMENTS

American Bitumuls & Asphalt Co.—"Bitumuls Surface Treatment Manual" is a two-color, 64-page round-up of factual, practical information on all phases of this type of pavement maintenance. Of special note is the attention given to proper evaluation of pavement distress ahead of specifying type of treatment. The manual is heavy on the "how-to" aspects of treatments, from "Black Seal" through "Armorcoats." Other features include a "Glossary of Terms" and a section of useful tables.

183 SURVEY DEPTH RECORDER

Edo Corp.—Literature describes and illustrates Models 255C and 255D Survey Depth Recorders, with sample recordings. Precision sonar equipment measures depth of water (0-230 fathoms) with great accuracy. Compact unit is readily installed on all types of survey vessels. Model 255D, with narrowed beamwidth, records with exceptional detail in relatively small areas.

184 SURVEYING INSTRUMENTS

Fennel Instrument Corporation of America—A 12-page, illustrated folder titled "Surveying Instruments" covers a complete line of levels and transits from builders' instruments to Theodolites, including tilting levels and enclosed transits. Also available are two fully illustrated leaflets on the "Aubon", a low price, self-leveling level, and the "Seth", a one-sec direct reading Theodolite.

185 SURVEYING INSTRUMENTS

Filotenica Salmoiraghi, Inc.—The company offers free of charge a General Catalog and detailed manuals on the fine Levels (self-leveling and conventional), Optical Theodolites, Planimeters, etc. advertised in "Civil Engineering" and other professional magazines. The F/S instruments, made since 1865 in Milano, Italy, are distributed and serviced by the leading dealers throughout the United States.

Turn to page 126 and order your literature.

COMPACT POWER-PACKED ACKER TEREDO CORE DRILLS

SPEEDS SOIL SAMPLING

IN A VARIETY OF WAYS:

- Drive Sampling
- Undisturbed Sampling
- Penetration Testing
- Permeability Testing
- Wash Boring
- Driving Casing
- Rock Coring
  and many more!

Whatever the sampling technique, the Acker Teredo is up to it! Its modern design and host of useful features makes the Teredo the most useful you can buy!

It's ruggedly built, yet compact and light enough to be completely portable. Mount it on skid base, truck or trailer and power it with gasoline, diesel, electric or air motor. It's easy to use — inexpensive to operate!

Write today for Bulletin 30-R-CE.

ACKER DRILL CO., Inc.
P.O. Box 830
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Over 40 years of experience manufacturing a complete line of diamond and shot core drills, accessories and equipment.

Moves Huge Volumes of Water
FAST

JOHNSTON VERTICAL
PROPELLER
PUMPS

- Pumps to 100,000 gpm.
- Always primed
- Heaviest construction
- Takes small space

FOR: water supply, municipal raw water stations, dewatering, general industrial use.

PUMPS LIQUIDS FROM: rivers, lakes, ditches, canals, sumps, shipholds, dams.

Write for colorful bulletin.

JOHNSTON
PUMP COMPANY
A Division of the
Youngstown Sheet and Tube Company
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JOHNSTON PUMP CO.
BIN K, PASADENA, CALIF.
Send complete information on Propeller Pumps.

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FIRM________________

CATALOG DIGESTS

186 SURVEYING INSTRUMENTS

W. & L. E. Gurley—The complete line of Gurley surveying and engineering instruments, including transits, levels, alidades, are described in the revised edition of Catalog 50. Transits described include the Hell Gate Precise Transit; Standard Precise Transit; Gurley Telescopic Solar Transit; Standard Precise Mining Transit; Optoplane Precise Transit for industrial use; Optical Plummet Transit. Included are cross-sectional drawings of many of the transits.

187 SURVEYING INSTRUMENTS

Kern Instruments, Inc.—A 32-page brochure offers a brief description of the most important instruments manufactured by Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are theodolites, levels, self-reducing tachometers, alidades, pentagonal prisms and many other instruments.

188 SUSPENSION BRIDGE TECHNICAL DATA

John A. Roebling's Sons Div. of The Colorado Fuel & Iron Corp.—A 12-page booklet containing the necessary information to enable the designer, builder or user of a small suspension bridge to make up preliminary calculations is now available. Included are approximate lengths and cable tensions, catenary formulas, erection calculations, and notes on suspension bridge design.

189 TAMPER BROCHURE

The Jay Co.—Entitled "The Best On Earth", this brochure gives complete information about all 3 sizes of tampers and the performance rates of each machine. It includes basic information on the J-Tamp—the new J-18 and the J-36 and color photographs of all machines as well as on the job applications in all heavy construction areas.

190 TECHNICAL BOOK WRITING

F. W. Dodge Corp.—The booklet is written to help authors organize and develop their ideas for books to the point where they can obtain the support and backing of a publisher. It answers a great many questions about the author-publisher relationship, and it also presents many practical checklists for preparing material for publication.

191 TECHNICAL PAPER

Clearprint Paper Co.—Some of the products contained in this booklet are: Clearprint 1000, a technical paper for drawing and tracing; Papercloth, a technical paper of cloth durability; graph paper; and Fade-Out paper. Price lists and specifications are also included.

192 TEREDO DIAMOND BIT CORE DRILL

Acker Drill Co., Inc.—Bulletin 30-R describes and illustrates the Acker Hydraulic Feed and three speed mechanical feed Teredo core drills. The Teredo is a compact, lightweight, versatile core drill particularly useful for soil sampling. The rig is self-contained with its own power plant, hoist and water pump. It can be mounted on trailer, truck or skid.

193 TESTING APPARATUS

Soiltest, Inc.—A "new-products" bulletin is available which describes ten recently developed items that have been added to the company's line of testing apparatus. Included in the list of items are apparatus for concrete, soils and asphalt testing, as well as the Soiltest Beggs Deformeter for solving problems involved in the design of indeterminate structures.

194 TESTS FOR CONCRETE QUALITY CONTROL

Soiltest, Inc.—A 6-page folder on the Three Basic Tests for Concrete Quality Control is now available. The leaflet shows how the slump test, air entrainment determination and testing of concrete cylinders is performed. Photographs illustrate the major steps in each testing operation. In addition to the equipment needed to perform the specific tests, there are other illustrations of testing equipment pertinent to the concrete quality control field.

195 THE COMPLETREATOR

Dorr-Oliver, Inc.—An 8-page, two-color bulletin entitled, "The Dorr-Oliver CompleTreator" describes the compact design, operation and advantages of the package-type unit for small plants. Also included in Bulletin #7315, are a line drawing, flow diagram and a series of photographs showing the step-by-step installation of a unit.

196 THE MARCONI REVIEW

Marconi's Wireless Telegraph Co. Ltd.—Devoted to the advancement of the science of radio engineering, this technical journal contains articles on the latest research and development in the fields of radio and electronics. Published quarterly, "The Marconi Review" is written primarily for the laboratory worker and reflects the highest standard of industrial research. The subscription rate is £1.0.0 annually, postage free to any part of the world.

197 THEODOLITE

Eugene Dietzgen Co.—A 6-page brochure describes in detail the Dietzgen Watts Theodolite #1 and #2. This brochure also contains information on the company's Watts Autoset (self leveling) Level, the Microptic Engineers' Level and the Precise Level.

198 TIDE GATES

Brown & Brown, Inc.—Literature fully describes a complete line of metal tidal gates in 22 circular sizes and 47 rectangular sizes. Also described are timber gates to meet any requirements and a line of cushioned flap gates for use on pump discharge lines. Dimensional and loss of head data are given.

199 TRACTOR SHOVEL

Allis-Chalmers Mfg. Co.—Operating performance and maintenance features of the recently introduced 1½ cu yd HD-6G tractor shovel are explained in an 18-page, 2-color catalog, MS-1344. Two pages are devoted to front and rear-mounted attachments which increase the versatility of the unit. Tractor and engine specifications are included.

200 TRACTOR STANDARDS

Caterpillar Tractor Co.—Five standards for measuring big tractor value are described in "Five Yardsticks", an 8-page booklet, #33341. Performance, dependability, matched equipment, serviceability and dealer organization are the five standards listed in the two-color brochure. These yardsticks are applied to tractors in the D8-D9 class.

201 TRANSITE^R PIPE

Johns-Manville Corp.—Transite^R Sewer Pipe, made of asbestos-cement, available in 11 different diameters ranging from 6 in. to 36 in. and in 5 crushing strengths to permit greater efficiency in system design. Ring-Tite^R Coupling, designed for high-speed assembly, provides tight, long-lasting seal. Easy-to-assemble Transite sewer fittings with Ring-Tite assembly also furnished. Complete information is available from brochures TR-165A (Transite Sewer Pipe), TR-94A (Sewer Design Flow Chart), and DS-366 (Transite Specifications).

NOW NEW

Edo

MODEL 255C

SURVEY DEPTH RECORDER

more accurate, more versatile than ever

Hinged viewing window and housing which drops down to allow access to interior contribute to ease of operation and maintenance of Edo Model 255C Survey Depth Recorder.

EDO, acknowledged leader in the design and manufacture of echo-sounding devices, now offers a vastly improved Precision Survey Depth Recorder—Model 255C—for permanent or temporary installation aboard vessels of every size.

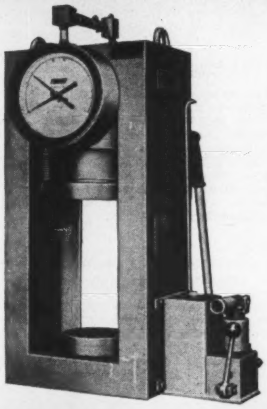
Extremely accurate, light in weight (only 55 lbs.) and easy to operate, Model 255C is the ideal recorder for deep depth, penetration and general underwater survey. Accuracy is within ½ of 1 per cent, in water depths from 1-½ feet to 230 fathoms. Bottom readings are recorded permanently and with knife-sharp definition on overlapping range scales, in feet or fathoms. Wide transducer beamwidth —20 degrees at minus 10 db points—assures excellent penetration and broad recorder coverage.

FOR CERTAIN SPECIFIC APPLICATIONS—such as underwater dredging and cable laying where detailed bottom contour information over a relatively small area is required—Edo also offers its new *Model 255D.* Conversion to the narrow beamwidth configuration (6 degrees at minus 10 db points) is achieved simply by the exchange of certain components of the 255C and substitution of a specially built transducer.

Send for new illustrated brochure, Dept 5 V

Edo CORPORATION, College Point, L. I., N. Y.

MODEL FT 20
JOBSITE
CONCRETE TESTER



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BRICK AND DRAIN TILE
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BOX 310, NEW CASTLE,
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MAYO Tunnel Cars

. . . feature practical designs and rugged construction. All cars can be equipped with Mayo's safe, automatic couplers.

- **Side Dump Car** (shown) has 2½ cu. yd. capacity. 24" gage.
- **Rocker Dump Car.** Ideal for sticky muck or wet concrete. 1 cu. yd. capacity 24" gage.
- **Tunnel Car.** Box body is removable and may be hoisted to surface to be dumped into truck. ½ to 2 cu. yd. capacity. 18" or 24" gage.

FREE Bulletin No. 18-b shows car details; No. 22 illustrates Automatic Coupler.

MAYO
TUNNEL AND MINE
EQUIPMENT
LANCASTER, PENNA.

CATALOG DIGESTS

202 TRANSITE^{R} PIPE

Johns-Manville Corp.—The installation, operation and maintenance economics of Transite^{R} Pipe and the Ring-Tite^{R} Coupling for pressure water lines are described and illustrated in four pieces of literature offered to engineers. They include DS-335, a material specification; TR-15A, a Friction Loss of Head and Flow Powergraph; TR-62A, an Installation Guide; and TR-160A, in service characteristics and case histories of Transite Water Pipe. Tables of weights, sizes and pressure classes are also included.

203 TRANSITS AND DUMPY LEVELS

Texas-Asiatic Import Co.—This literature describes the Eagle 6-in. Standard Transits (20-sec and 1-min horizontal verniers), which are made of solid bronze, with a unique 11-piece optical system and several refinements not found on any other instrument. It also describes the Eagle Engineer's Dumpy Levels, which are available in both an 18-in. and 15-in. model.

204 TRI-ACETATE SHEETS

Stanpat Company—Circular describing their printed adhesive-backed acetate sheets for speeding up drafting is available. These sheets are attached to original drawings and save draftsmen from redrawing standard details and repetitive notes. Resulting prints are clear and sharp and save tremendous amount of time.

205 TRUE MERIDIAN IN DEFENSE PLANT

Kern Instrument Inc.—Civil Engineers reprint describes the use of a Kern Theodolite to solve the difficult problem of establishing a true meridian inside of a defense plant for testing of weapons components.

206 "T-1" STEEL

Lukens Steel Co.—A description of Lukens "T-1" steel, its properties, uses, and fabrication techniques is included in a brochure.

207 TUNNEL AND MINE EQUIPMENT

Posey Iron Works, Inc.—A bulletin is available which describes and illustrates round conduit forms, full round non-telescopic tunnel forms, adjustable box forms, self-dumping skips, muck bins, man and material cages, and skip guide towers, pertaining to all types of steel forms and shaft equipment for tunnel and mine usage.

208 TUNNELS

Spencer, White & Prentis, Inc.—"Famous Subways and Tunnels of the World," by Edward and Muriel White recounts the fascinating history of subways and tunnels from earliest times. The price is $2.75.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

209 TYLOX "C-R" GASKETS

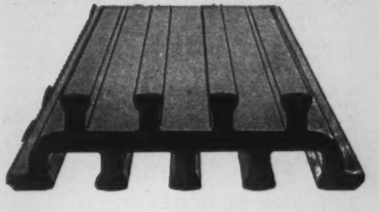
Hamilton Kent Mfg. Co.—A 4-page brochure in color fully describes and illustrates the use of Tylox "C-R", a new rubber gasket for recessed sewer pipe which cannot roll or twist out of position during pipe coupling operations. The gaskets are of the "snap-on" type for recessed concrete pipe of all sizes, and of either bell and spigot or tongue and groove types. They may be made of rubber or neoprene, and form a leak-proof, acid-resistant seal when pipe is coupled.

210 TYLOX "C" SERIES GASKETS

Hamilton Kent Mfg. Co.—A 4-page brochure in color fully describes and illustrates Tylox "C" and "C-P" sewer pipe gaskets now being made available to engineers and contractors. "C" and "C-P" and "snap-on" gaskets designed for concrete pipe of all sizes, with single or double offset, and provide true compression, leak-proof joints capable of withstanding pressures up to 50 ft. They are furnished in either rubber or neoprene, and may be installed on the pipe either at the pipe manufacturer's plant, or by contractors at the job site.

LABYRINTH
WATERSTOPS

A SOUND INVESTMENT
FOR CONCRETE CONSTRUCTION!



LABYRINTH AVAILABLE IN 2, 3 or 4 rib.

ON YOUR CONSTRUCTION:

1. Consider the investment in design, materials and labor (to mention a few).

2. Then consider how important safe, secure *watertight* concrete joints are.

3. Thorough watertightness *can* be secured by installing Labyrinth Waterstops—a dividend that makes the low initial cost of the product insignificant when compared to your total investment—and one that insures watertight concrete joints for years!

- Corrugated ribs grip concrete, insure an everlasting bond between joints.
- Finest polyvinyl plastic resists chemical action, aging, severe weather.
- Takes just seconds to nail to form . . . easy to cut and splice on location (prefabricated fittings available).
- There's a Water Seal product for every type of concrete work!

If your aim is to stop water seepage, *stop it effectively with Water Seals' Waterstops!*

"See Us in SWEET'S"

New Literature and Free Samples Sent on Request—Use Coupon Below

WATER SEALS, *inc.*
9 SOUTH CLINTON STREET, CHICAGO 6, ILL.

Made in Canada for J. E. Goodman Sales, Ltd.
Toronto, Ontario

WATER SEALS, INC. DEPT. 1
9 S. Clinton Street
Chicago 6, Illinois
Please send free sample and descriptive literature.

Name____________________

Company____________________

Address____________________

City__________Zone______State__________

CATALOG DIGESTS

211 UNDERPINNING

Spencer, White & Prentis, Inc.—"Underpinning," a book by Edmund Astley Prentis and Lazarus White is recognized as the authoritative source for information in the field by engineers, architects and contractors all over the world. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

212 VALVES, HYDRANTS AND ACCESSORIES

M & H Valve & Fittings Co.—Catalog 52 lists the company's products and services. These include valves in sizes 2 in.-42 in. for water, steam, etc., operated manually, hydraulically or by electric motor. Hydrants are standard, traffic or flush models.

213 VANE SHEAR TESTING

Acker Drill Co., Inc.—Bulletin 700-R describes and illustrates "in-place" vane shear testing techniques and the tools necessary to conduct the test.

214 VAPOR SEAL MANUAL

W. R. Meadows, Inc.—A manual has been prepared covering practical application of the "premoulded Membrane" Vapor Seal. This booklet covers architectural and engineering data, technical information, various applications and specifications.

215 VERIFAX COPIER

Eastman Kodak Co.—Three pieces of literature on the Verifax Copier are now available. They explain the workings and time-saving features of this office copier. Photographs are included in the brochures. Also available is a booklet entitled "Thirteen-minute processing", which describes a quick process for processing industrial x-rays.

216 VERSATILE WALL

H. H. Robertson Co.—A 16-page catalog describes the unique features built into the Versatile Wall. Many black and white and full color illustrations demonstrate the use of the wall on various types of buildings. Technical material includes standard detail drawings, load tables and specifications concerning this modern metal curtain wall that provides custom appearance at low cost through the use of well-designed basic components.

217 VERTICAL AND HORIZONTAL PUMPS

C. H. Wheeler Mfg. Co., Economy Pump Div.—A 12-page catalog describes Axial and Mixed Flow Vertical and Horizontal Pumps for application in flood control, irrigation and drainage projects, large scale primary water supply, industrial and process work, and power plant condenser circulating systems. These pumps are designed to pump extremely large volumes of liquids at low to medium heads. Capacities range from 5,000 to 200,000 gpm and over at heads from 5 to 75 ft.

218 VIBRATORY EQUIPMENT CATALOG

Jackson Vibrators, Inc.—Multiple Compactors for maximum consolidation of sub-base and base courses in macadam construction, fills, etc. Trailer type for use with prime movers. Manually guided Compactors for paving blacktop walks, drives, pavement patching, widening, consolidation of granular soils in trenches, close to abutments, concrete floor subbases, etc.; Concrete Vibratory Screeds; Vibratory Tubes for Internal and Surface Vibration in Concrete Paving; General Construction Vibrators; Portable Power Plants.

219 VISQUEEN FILM

Visking Co., Division of Union Carbide Corp.—The use of Visqueen film as a curing blanket is discussed in a new booklet. Lightweight, it provides easy handling. Moisture retention provides stronger concrete. The material is reusable; it will not rot, mildew or absorb moisture. It is also used as material and equipment cover.

220 WALK-TOP SURFACING

American Bitumuls & Asphalt Co.—"Walk-Top For Sealing and Smooth Surfacing Walks, Drives & Playgrounds" is not the title but best describes the subject covered in this three-color, four-page folder. It contains full details on sealing rough and open-textured pavements on low-traffic areas. The material is presented in "problem-solution" form, with "how-to" information. Also included is data on special sealing for solvent-resistance for such areas as airport hangar and service areas.

221 WATER

Cast Iron Pipe Research Assoc.—"Water—make sure you'll always have plenty" is a free booklet telling about the water problem. It shows how responsible citizens can acquaint themselves with the needs of their community. It also gives step-by-step outline of action, telling how they can help their officials extend and improve the local water system through more adequate rate structures or financing.

222 WATERPROOFING MATERIALS

Standard Dry Wall Products, Inc.—A 20-page brochure on Waterproofing Materials is available. Thoroclear gives invisible protection to new brick, prevents water stained plaster, eliminates the cause of unsightly efflorescence; Thoroseal is used for foundation coating to all exterior foundations; and Waterplug seals the junction between the floor, wall, around pipe openings, and settling cracks.

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223 WATERSTOP MANUAL

W. R. Meadows, Inc.—The availability of a manual on "Sealtight" PVC Waterstops has been announced. It describes applications, installation information, product specifications and engineering data, and gives complete range of product sizes and types.

224 WELDED RAILING

Tubular Products, Inc.—This catalog provides the basic data needed for design and specification of welded or fitted railing in steel or aluminum, in round or special shapes, for industrial, commercial, safety and ornamental uses. The catalog has tables showing the dimensions, bend radii and elbow radii for the common sizes of pipe used in railing. Various standards are given for fabrication, finish and availability of fittings.

225 WELDING OF CONCRETE REINFORCING BARS

Bethlehem Steel Co.—Twenty pages of recommendations for the sound welding of concrete reinforcing bars, joint details, and other information to help develop full tensile strength of the material being joined has been made available.

226 WELLPOINT DEWATERING

Griffin Wellpoint Corp.—This equipment catalog contains specifications and performance data for Griffin pumps, wellpoints and other equipment.

227 WELLPOINT DEWATERING

Griffin Wellpoint Corp.—"How to Handle Wet Jobs," a brochure presenting successful solutions to unusual pre-drainage problems is available.

228 WELLPOINT DEWATERING

Griffin Wellpoint Corp.—"The Griffin Wellpoint System", a 32-page digest showing a wide variety of wet jobs, many of which present unusual dewatering problems, is now available.

229 WELLPOINT SYSTEM

Moretrench Corporation—an informative 76-page catalog, fully illustrated, describes the Moretrench wellpoint system and its use in dewatering various types of construction projects. It includes useful technical data on the system.

230 WINDOWS & CURTAIN-WALLS

William Bayley Co.—Windows and Curtain-walls, steel or aluminum, are described with catalogs. Catalog S-59 covers steel windows and doors; Catalog C-59 covers curtain-wall systems and panels; Catalog A-59 covers aluminum windows; and Catalog D-59 covers detention window systems.

231 WIRE ROPE

Leschen Wire Rope Div., H. K. Porter Co., Inc.—This bulletin includes description of the five main resistance factors to be considered in selecting the proper wire rope construction for any application together with the basic principles to use in judging the factors. Typical uses of more popular constructions are listed with reasons why they are normally selected.

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232 WOOD & STEEL TYPE DOORS

The Kinnear Mfg. Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 101 it gives information on installation, clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

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CATALOG DIGESTS

233 WATER STORAGE TANKS

Chicago Bridge & Iron Co.—An illustrated, 24-page booklet describing the company's elevated and ground water storage tanks has been made available. Of special interest is a series of drawings depicting the evolution of elevated steel tanks. Photographs of the company's contracting engineers are also included.

234 STRUCTURAL WELDED DESIGN

The Lincoln Electric Co.—Series of studies in structural welded design are issued periodically. Current series is set of charts for easily determining constants with which to find final moments for supports in continuous framing over which cover plates have been welded.

235 WATERSTOPS

Electrovert Inc.—A newly issued, 4-page brochure describes properties and engineering advantages of Durajoint PVC waterstops. They retain their flexibility indefinitely, eliminate leakage due to fatigue, breakage, oxidation, or chemical deterioration. Specialized tri-faced ridge construction, detailed in the brochure, allows correct pressure distribution, virtually eliminating hair line fractures. The booklet provides cross-section drawings, engineering specifications, and application details of the complete range of sizes and types available from the manufacturer.

236 GENERAL PURPOSE COMPUTER

Royal McBee Corp., Data Processing Div.—The LGP-30 General Purpose Computer Brochure S-526R1 gives specifications, basic features, illustrates major components and lists applications. Operation of control panel and simple 16-part Command Table are described. New optional photo-electric punched tape Reader (200 characters per second), and combination high-speed Reader and Punch unit are illustrated.

237 VERTICAL TURBINE PUMPS

FIESE & FIRSTENBERGER, INC.—A new 8-page brochure illustrates the several types of FloWay pumps which are designed to fulfill every pumping need of industry. The brochure shows construction and designates materials used for various fluids—corrosive, non-corrosive, volatile, non-volatile, hot or cold. It also lists typical applications for each pump design.

238 KWIK-SEAL WATERSTOP

The Gates Rubber Company Sales Div., Inc.—This 4-page brochure gives examples of installations as well as description of features, design, operation, comparative data, types and sizes, physical characteristics, selection, application data, installation, specifications, and engineering service. In addition, there is a complete list of regional sales offices and warehouses where this product may be obtained.

239 STEEL SHEET PILING

L. B. Foster Co.—A 24-page catalog (#400) lists the advantages of renting interlocking steel sheet piling and contains specifications for piling sections, as well as corners and connections. Drawings illustrate various types of sheet piling, and data is provided on dimensions, weight, and section modulus. Diagrams showing construction of several types of cofferdams are also included. On-the-job photos illustrate several typical installations.

240 BUTTERFLY VALVE MANUAL

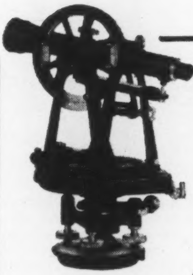
The Henry Pratt Co.—Catalog B-2 is a tool designed to help the engineer select the class of Rubber Seat Butterfly Valve his work requires, determine the space needed for its installation, and understand its characteristics. Because of the many possible combinations of valves and valve operators, no attempt has been made to detail complete assemblies. Instead, this manual employs a flexible approach, cataloging valves and operators separately, and allowing the designer complete freedom in selecting the best possible valve-operator combination for his particular application. Also available is Catalog 451 entitled "Air Locks for Nuclear Reactor Containment Vessels."

241 POSITIONS AND PERSONNEL AVAILABLE

Cadillac Associates, Inc.—Two monthly publications are offered without charge: The Career Builder, containing complete descriptions of the best available positions in the construction industry; and The Construction Engineer Finder, for firms who are seeking executives and engineers. Typical of the executive requirements listed in the current issue of The Career Builder are verified openings for president, general manager, chief engineer, and project engineer.

242 HELICOPTER

Hiller Aircraft Corp.—Included in this 12-page brochure are colorful pictures of the 12E Helicopter, detailed construction and equipment features and a performance summary. Supplying inaccessible places is a duty for which the 12E's greater payload capacity and long range make it more than suitable.



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Journals: Construction, Highway, Hydraulics, Irrigation and Drainage, Sanitary Engineering, Structural, Surveying and Mapping, Waterways and Harbors, Professional Practice.

2141. Foundation Installation Requiring Recharging of Ground Water, by James D. Parsons. (CO) The foundations of the structures described required extensive dewatering and diffusion facilities to be provided for their installation. The diffusion system described is believed to be the first of its type to be employed.

2142. Ventilated Building Foundations in Greenland, by Roger H. Williams. (CO) This paper describes the ventilated foundation systems used in permafrost areas in Greenland. Problems of heat transfer, moisture content, ground water conditions, and structural details which affected design are presented.

2143. Construction of the Columbia River Bridges, by Ivan D. Merchant. (CO) This paper covers some of the more interesting problems encountered in remodeling a bridge constructed in 1914-15 to provide greater vertical and horizontal clearances for river navigation and in the construction of a new parallel bridge.

2144. A Plan For a County Motor Vehicle Transportation System, by Victor W. Sauer. (HW) Contra Costa County, California, has developed a plan for a road network serving present and future needs. As a technical feature, traffic data is coded on a grid system basis, thus facilitating re-use of information.

2145. Pavement Design Practices in Virginia, by K. E. Ellison. (HW) Virginia utilizes a modified CRB method for designing highway pavements. The primary and Interstate Systems are divided into 6 classes based on the weight and volume of truck traffic. The secondary system is similarly divided.

2146. The Electronic Computer in Highway Engineering, by L. R. Schureman. (HW) This paper describes electronic computers and their functional components; operating techniques; the procedure for their use in the solution of engineering and highway problems.

2147. Flood Control Aspects of the Cauca Valley Development, by Phillip Z. Kirpich and Carlos S. Ospina. (HW) The Cauca Valley project applies two techniques relatively new in Latin America: integrated water-resource development and administration by a decentralized, TVA-type agency. These measures for flood-control are presented in this paper.

2148. Friction Factors in Corrugated Metal Pipe, by Marvin J. Webster and Laurence R. Metcalf. (HY) A study made to determine friction co-efficients for flow in large corrugated metal pipe and to determine typical distribution of velocities in each test pipe for several discharges is presented in this paper.

2149. Revised Computation of a Velocity Head Weighted Value, by Joe M. Lara and Kenneth B. Schroeder. (HY) A revised computational procedure is proposed on the determination of a weighted value of the velocity head. An example of the procedure is illustrated by a hydraulic computation of the discharge of a stream using the slope-area method.

2150. Eddy Diffusion in Homogeneous Turbulence, by Gerald T. Orlob. (HY) Taylor's theory of diffusion by continuous movements and the Einstein equation of diffusion were applied to eddy diffusion of particles in a two dimensional field of homogeneous turbulence produced by broad shallow channel with extreme bottom roughness. Results are reported herein.

2151. Education for Continuous Irrigation in the Humid Areas, by Billy B. Bryan. (IR) As educators, irrigation engineers should be familiar with the factors effecting costs, production and consequent net profits. This paper presents an analysis of data concerning these and other factors.

2152. Discussion of Proceedings Paper 1563, 1694, 1695, 1709, 1710, 1711, 1712, 1817, 1819, 1838, 1839, 1854, 1878, 1910, 1911, 1913, 1914. (ST) D. F. Moran and J. A. Cheney closure to 1563. Bengt Broms and I. M. Viest closure to 1694. John A. Blume closure to 1695. Glenn B. Woodruff and John J. Kozak closure to 1709. Thomas W. Signell closure to 1710. W. Watters Pagon closure to 1711. F. B. Farquarson closure to 1712. Louis Balog on 1817. Chu-Kia Wang closure to 1819. Lymon C. Wood closure to 1838. R. F. Luxford closure to 1839. James S. Hoffman corrections to 1854. Herbert A. Sawyer, Jr. on 1878. F. T. Mavis on 1910. Ivan M. Melidov on 1911. E. George Stern on 1913. J. J. Polivka on 1914.

2153. Annual Droughts, by Marion Clifford Boyer. (IR) The effects of annual droughts are reflected in the growth of tree rings, the formation of varves, records of temperature and precipitation, and the yield of crops. A study of weather records and the yield of corn in Iowa is presented.

2154. Laboratory Research on Interceptor Drains, by Jack Keller and A. R. Robinson. (IR) This paper reports the results of a large scale model study concerned with the design of interceptor drains. Relationships are developed for estimating the flow from the drains.

2155. Developing Storage for Irrigation Water in the Humid Areas of the United States, by T. H. Quackenbush. (IR) The factors that affect the development of irrigation storage facilities in humid climates are discussed. Also included are modifications in design and planning criteria.

2156. Aquifer Tests in the Snake River Basalt, by W. C. Walton and J. W. Stewart. (IR) The results of 11 aquifer tests and specific capacity data for 238 production wells indicate that the coefficient of transmissibility of the Snake River basalt ranges from 1 x 10^5 gpd per foot to 1.8 x 10^7 gpd per foot and averages about 4 x 10^6 gpd per foot.

2157. Consolidation of Irrigation Companies and Systems, by A. Alvin Bishop. (IR) The problems of the old irrigation systems diverting water from a common source are pointed out and recommendations are made concerning consolidation of irrigation companies and systems.

2158. Drainage in the Coachella Valley of Califorina, by Lowell O. Weeks. (IR) The program of drainage for the Coachella Valley was based upon salinity content of drainage waters and soils; soils in relationship to the movement of water.

2159. Progress on Barrier to Sea Water Intrusion, by A. E. Bruington. (IR) Engineering and geologic exploration and planning proceeds for an 11-mile fresh water barrier to sea water intrusion in a ground water reservoir in Los Angeles County, California.

2160. Drainage Problems of the San Joaquin Valley, by William L. Berry and Edward D. Stetson. (IR) This paper outlines the geography and geology of the San Joaquin Valley of California, with special emphasis on the factors affecting drainage. Current drainage problems are unfolded through a description of the cultural changes that have brought them into sharp focus.

2161. Sewage Sludge Disposal in Westchester County, by Guy E. Griffin. (SA) The paper discusses the quantity and costs of sewage sludge disposal for several of the Westchester County plants.

2162. Filter Plant Design, by Richard Hazen. (SA) The recent design of several filter plants for municipal and industrial purposes has provided opportunity for critical analysis of laboratory data and actual plant performance.

2163. Stability Considerations in the Design of Steel Columns, by Charles Massonnet. (ST) Two problems in the field of stability are considered: the behavior and design of steel columns subjected to thrust and unequal end moments;

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the behavior and design of plate elements liable to buckling.

2164. Analysis of Curved Girders by H. H. Fickel. (ST) This paper presents the derivation of influence lines for bending and torsional moments and shears on horizontally curved girders. Solutions are given for simple and continuous spans.

2165. The Set-Up Error In Horizontal Angles, by Sumner B. Irish. (SU) The effect of the set-up error on the accuracy of a horizontal angle is determined. Causes of angular error are presented. Graphs are included to facilitate the evaluation of the developed expression.

2166. Status of Surveying and Mapping in the United States: Final Report of the Task Committee on Status of Surveying and Mapping of the Surveying and Mapping Division, by Austin B. Barry. (SU) A classification chart shows the distinction between professional-level and technician-level work, as well as between engineering and non-engineering in surveying-mapping activities.

2167. Deepening of Wilson Lock Eliminates Third Lockage, by W. F. Emmons and O. Lavik (WW) TVA is building a new large single-lift lock at Wilson Dam to replace the present 35-year-old triple-lift lock system. The old system will be utilized for standby service.

2168. Engineering Aspects of Coastal Sediment Movement, by Richard Silvester. (WW) Current knowledge of foreshore processes are summarized. The predominant swell in sediment transport and coastal physiography is stressed. Certain conclusions are presented respecting scale models of coastal sediment movement.

2169. Present State of Coastal Engineering in Japan, by Kiyoshi Horikawa. (WW) Japanese engineers are striving successfully to improve the status of coastal engineering in Japan. A complete bibliography of Japanese publications on this subject is presented.

2170. Rincon Offshore Island and Open Causeway, by John A. Blume and James M. Keith. (WW) This paper presents the design problems and the construction techniques involved in creating a man-made island of sand, rock and precast concrete armor in the Pacific Ocean offshore from California.

2171. Laboratory Investigation of Rubble-Mound Breakwaters, by Robert Y. Hudson. (WW) Laboratory tests have been conducted to determine stability characteristics of various armor-unit shapes, and a new stability formula for rubble breakwaters was developed.

2172. Design of Seawalls and Breakwaters, by Ira Hunt. (WW) This paper discusses seawall and breakwater design from the standpoint of the manner and effectiveness with which they reflect or dissipate the incident wave energy.

2173. An Electric Analog Model of a Tidal Estuary, by H. A. Einstein and James A. Harder. (WW) Five hundred miles of channel in the Delta Region, California, now subject to sea water encroachment, may be protected by salinity barriers and a master levee system. An electric analog model developed at the University of California predicts tidal amplitude and flows resulting from such modifications to the hydraulic system.

2174. Breakwater at Crescent City, California, by John E. Deignan. (WW) The outer breakwater at Crescent City, completed in 1957, used tetrapods as the armor stone for the last section. This paper reviews the problems created by the use of tetrapods.

2175. A Breasting Dolphin for Berthing Supertankers, by John M. Weis and Virgil Blancato. (WW) The design of a flexible dolphin type structure for berthing 100,000 ten supertankers in deep-water locations is presented.

2176. New York State Barge Canal System, by Edward C. Hudowalski. (WW) This paper describes the history, the engineering and the economic effects of this Canal System.

2177. The Supply and Loss of Sand to the Coast, by J. W. Johnson. (WW) A summary of the various sources of supply and loss of sand to the coast is presented with special application to a reach of the coast of California.

2178. Discussion of Proceedings Paper 1955, 1956, 1957, 1958, 1959. (CO) Paul F. Keim, Frank W. Stubbs Jr. and Ellis Danner on 1955. William Hershleder and Henry G. Howard on 1956. Robert F. Borg on 1957. Henry G. Howard on 1958. Theodore B. Appel Jr., Paul F. Keim and Henry G. Howard on 1959.

2179. Discussion of Proceedings Paper 1963, 1964, 1965. (IR) N. A. Halkias on 1963. David K. Todd and Jacob Bear on 1964. J. Ernest Flack on 1965.

2180. Discussion of Proceedings Paper 1626, 1800, 1899, 1900. (HW) Abdun-Nur closure to 1626. Bengt F. Friberg on 1800. Carlton N. Conner, C. W. Britzius, K. P. Woods, L. S. Blake, H. F. Clemmer, E. J. Kilcawley, Ellis Danner, Maclean & Jones, Springenschmid, V. J. Brown, H. F. Winterkorn, W. R. Thomson on 1899. Ming L. Pei on 1900.

2181. Discussion of Proceedings Papers 1780, 1847, 1850, 1930, 1984. (SA) Tsung-Lien Chou closure to 1780. Edward J. Cleary closure to 1847. Sinkoff, Geilker and Rennerfelt closure to 1850. R. H. Burns and L. Carlbom on 1930. M. B. McPherson & M. Joseph Willis, Paul Bock, Carl F. Izzard & Charles Armentrout, Tsung-Lien Chou on 1984.

2182. Discussion of Proceedings Paper 1807, 1934, 1935, 1960, 1961, 1962, 1996, 1997. (HY) Warren B. McBirney on 1807. Max A. Kohler on 1934. J. R. Bowman on 1935. P. K. Kandaswamy and Rajaratnam, T. R. anand on 1960. R. Silvester, Ivan M. Nelidov, Walter J. Tudor, Warren W. DeLapp on 1961. K. Szesstay, Henry J. Miles, M. B. McPherson, Nicholas Bilonok, J. V. Dawsey on 1962. Charles Jaeger on 1996. R. Silvester on 1997.

2183. Discussion of Proceedings Paper 1697, 1842. (SU) Committee on Highway and Bridge Surveys closure to 1697. R. Robinson Rowe, Woodland G. Shockley, John A. Focht, Jr., David M. Greer, Ralph F. Reuss, E. J. Zegarra on 1842.

2184. Discussion of Proceedings Paper 1568, 1770, 1789, 1874, 1976. (WW) Charles L. Bretschneider closure to 1568. Shu T'ien Li closure to 1770. Ray E. Holmes closure to 1789. David M. Rockwood on 1874. R. Silvester on 1976.

2185. Discussion of Proceedings Paper 1868, 1869, 1870, 1871, 1872. (PP) Committee on Engineering, Education, Los Angeles Section on 1868. Henry G. Howard on 1869. Hotten A. Elleby and Frank A. Butrico on 1870. C. J. Posey, John E. Kiker, Jr. and Lee H. Johnson on 1871. Alfred C. Ingersoll and Frederick L. Hotes on 1872.

2186. Discussion of Proceedings Paper 1707, 1821, 1939, 1942, 1943, 1970, 1974, 2005, 2035. (ST) J. M. Biggs closure to 1707. R. S. Rowe closure on 1821. L. Cizek on 1939. A. A. Eremin on 1942. J. J. Polivka on 1943. Richard T. Douty on 1970. Alfred Zweig, M. Zar and W. H. Munse on 1974. A. Hrennikoff on 2005. Roy Levy, C. W. Cunningham and James Chinn on 2035.

2187. Methods of Accomplishing Professional Development, by N. W. Dougherty. (PP) Professionalism is presented as a way of thinking and living rather than as an accumulation of knowledge and power.

2188. Report of the Committee on Salaries of the ASCE Department of Conditions of Practice. (PP) This paper reports in detail the results of the 1959 ASCE survey of Civil Engineers Salaries. Comparisons with the results of the 1957 survey are included.

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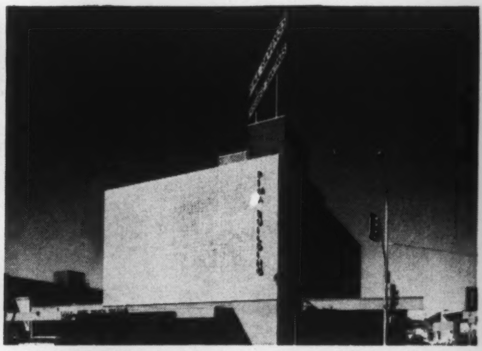

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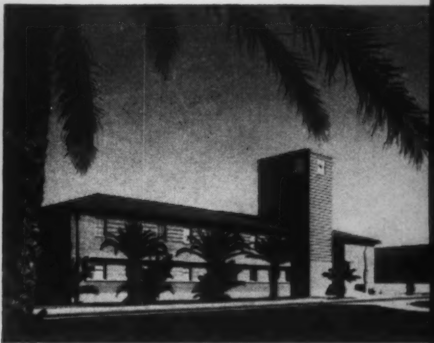

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